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FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 87 Thursday, October 6, 1949 No. 1727

49, Wellington Street, London, W.C.2
Grams: "Zacatecas, Rand, London"
'Phone: Temple Bar 3951 (Private Branch Exchange)
PUBLISHED WEEKLY: 26s. per annum (Home and Overseas)

The New Era

The most serious impact of devaluation, so far as the foundry industry is concerned, has fallen on the non-ferrous section. The cost of the metallic raw materials has advanced so greatly that there will have to be much thought given to every aspect of trading. This will have to include financing, stocking, metal losses, alternative alloy composition, manufacturing technique, metal reclamation and selling. In the field of iron castings, there is a dual aspect; the alloyed, high-duty variety will cost more, but on the other hand, competition from non-ferrous alloys should be reduced. The output of the alloyed grades of steel castings has been greatly increased in recent years, and no doubt attention will have to be given to getting the best properties out of simple compositions. Whilst not exactly a virgin field, this still shows distinct potentialities.

Following hard upon the heels of devaluation, the Government have published an extremely lengthy list of plant and materials which can be bought free from licence from countries not tied to the dollar or other hard currencies; included amongst raw material are pig iron, a few of the rarer metals, and some chemicals used in the industry. The market for builder's castings is now open to importers, and no licence is needed to import stove grates, pipes, baths, flushing cisterns and the like. Not only can machinery of a particularly wide range be imported, but also the iron and steel castings for their manufacture. Indeed, so great is the variety that it is impossible to assess the impact on home manufacturers, when the scheme is fully developed.

So far as the foundry industry is concerned, there seems but little to worry about at the moment, because licences are still necessary for imports from Germany, Belgium, Luxembourg and Czechoslovakia. Of the European industrial countries, there are virtually only France and Italy remaining. It so happens that both these countries are busy modernising their own plants and, we should imagine, have but little excess machinery and castings for export. Moreover, today, this country is much better placed to supply itself with foundry plant from indigenous sources than before the war. In fact, progress in the manufacture of foundry equipment has been such that, where firms do not manufacture under American license, they will be encouraged to export to dollar countries. One can presume that some reciprocity will be the outcome of this easing of business relations, and if that be so, there should be an increase in exports to countries within the sterling area. The Government have placed a great responsibility on industry to do three things:—(1) To increase exports; (2) to raise productivity; and (3) to manufacture more cheaply. If the third edict can be accomplished the other two can take care of themselves. Yet, since the foundry industry has the cost of its fuel, metals, scrap and labour at fixed rates, there only remains the actual manufacturing processes. Thus, for increased exports, a serious attack must be made on that one factor. At the moment, in many countries, permission to import even the most trivial of articles has to have the sanction of some department of state. It is still an age of controls, but with this removal of licences to import we see the dawn of a new era. Whether it will bring fair or foul weather is unpredictable.

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I.B.F. Golf Competition

Successful Event at Woodhall Spa

The Annual Golf Competition of the Institute of British Foundrymen was played-off this year at Woodhall Spa, Lincs. The arrangements were all made by Mr. R. C. Shepherd and his choice of the Golf Hotel met with general approbation. The members found Woodhall Spa to be an ideal venue for a function of this type. The weather was poor on the opening day, providing a mixture of fine rain and heavy showers. The second day, however, was one of brilliant sunshine. The president of the Institute, Mr. Noel Newman, had kindly presented two tankards as prizes. They were won by Mr. Compton Lake and Mr. R. B. Templeton, Mr. Shepherd being the runner-up in both cases. Below are the detailed results of the major events.

I.B.E. Handicap Cup Results.

Competitor's name.	Branch.	Handicap.	Score. Gross.	Nett.
Crompton Lake	London	13	87	74
R. C. Shepherd	Lincs.	12	87	75
R. B. Templeton	London	6	84	78
S. Kerr	Lincs.	9	88	79
H. Ward	London	14	93	79
G. Nicholls	W.R.Y.	12	93	81
F. Arnold Wilson	London	12	93	81
A. J. Stokes	London	14	95	81
D. Killingworth	Lincs.	19	102	83
P. B. Lake	London	8	93	85
R. S. Darby	Birmingham	9	94	85
E. A. Phillips	Lincs.	6	95	89
E. C. Carrott	Lincs.	24	115	91
P. H. Wilson	East Midland	18	111	93
D. Carrick	London	22	121	99
G. W. Brown	Birmingham	24	139	115
A. Swaln	Lincs.	21	No return	
L. A. Bailey	East Midland	6	No return	

I.B.F. Scratch Cup Results.

Competitor's name.	Branch.	Gross score.
R. B. Templeton	London	84
R. C. Shepherd	Lincs.	87
Crompton Lake	London	87
S. Kerr	Lincs.	88
G. Nicholls	W.R.Y.	93
P. B. Lake	London	93
H. Ward	London	93
F. Arnold Wilson	London	93
R. S. Darby	Birmingham	94
E. A. Phillips	Lincs.	95
A. J. Stokes	London	95
D. Killingworth	Lincs.	102
P. H. Wilson	East Midland	111
E. C. Carrott	Lincs.	115
D. Carrick	London	121
G. W. Brown	Birmingham	139
A. Swaln	Lincs.	No return
L. A. Bailey	East Midland	No return

On the Sunday morning, there was a Greensome Bogey Competition. This was won (2 up) by Mr. E. A. Phillips and Mr. Compton Lake, whose combined handicap is 7. In the afternoon a match against the Lancashire Transport Golfing Association resulted in a tie.

Forthcoming Events

OCTOBER 8.

Institute of British Foundrymen.

Lancashire Branch :—Presidential address; "Loam Moulding," by W. H. Hornby, at the Engineers' Club, Albert Square, Manchester, at 3 p.m.

Newcastle Branch :—Visit to C. A. Parsons & Company, Limited.

Scottish Branch :—Presidential address; "Apprentice Training in the Foundry Industry," by W. S. Cormack, at the Royal Technical College, George Street, Glasgow, at 3 p.m.

West Riding of Yorkshire Branch :—"Brains Trust," at the Bradford Technical College, at 6.30 p.m.

OCTOBER 11.

Institute of British Foundrymen.

Coventry Students' Section :—"Melting Furnaces," by L. W. Bolton, at Room A.5, Coventry Technical College, at 7.15 p.m.

East Anglian Section :—"Radio-active Materials and their Use in the Foundry," by A. Gottfeld, at the Central Hall, Public Library, Ipswich, at 7 p.m.

Royal Statistical Society.

Industrial Applications Section—Tees-side Sub-group :—"Operational Research in War and its Extension to Industry," by T. A. Evans, at the William Newton School, Norton, Stockton, at 7.15 p.m.

OCTOBER 12.

Institute of British Foundrymen.

Birmingham Students' Section :—"Production and Properties of Alloy Cast Iron," by D. Marles, at Dudley and Staffordshire Technical College, at 7.15 p.m.

OCTOBER 13.

Foundry Trades' Equipment and Supplies Association.

Annual general meeting at the Waldorf Hotel, London, W.C.2, at 12.45 p.m.

Institute of British Foundrymen.

Lincoln Branch :—"Some Examples of Loam Moulding," by W. H. Hornby, at Lincoln Technical College, at 7.15 p.m.

Institution of Works Managers.

Bristol Branch :—"Teamwork and Productivity," by A. P. Young, at the Royal Hotel, Bristol, at 7.15 p.m.

OCTOBER 14.

Institute of British Foundrymen.

Birmingham Branch :—Smoking concert and Supper, at the White Horse Restaurant, Birmingham.

Photography in Industry

At the Alpine Gallery, 74, South Audley Street, London, W.1, there is now being held (until October 15) an exhibition of photography in commerce and industry organised by the Institute of British Photographers. This is a show which should be visited by all those people who control the publicity of industrial products, for here one sees just what the really high-grade photographer can do to focus attention on manufacturing activities. It is relatively easy to make a pretty picture of an artistic object, but to make one look twice at a heap of sand carrying a couple of shovels is typical of the work of the modern photographer. For decades, pictures of steelworks have shown the wildest of steel being cast; now, at long last, the steel is shown—as it should be—properly "killed." One picture—"Inferno"—shows the tapping of an electric furnace complete with a multitude of sparks which, to our representative's mind, are as unnecessary as they are unattractive. The pictures of magnesium casting and a light-alloy heat-treatment furnace have come out very well.

Making Special-duty Castings in Aluminium Alloys*

By J. Caven and H. W. Keeble, A.I.M.

(*Continued from page* 406.)

Casting Made with Improvised Box Equipment, Strickles and Heavy Chilling

The seven-feet dia. spinning chuck casting is typical of a large casting which involves expensive equipment to make unless treated on jobbing lines, *i.e.*, strickles and section core box style of pattern equipment with improvised moulding boxes. The details of the casting were as follows:—(1) It was saucer shaped and carried a 10-in. dia. central boss with radial stiffening webs; (2) had a general wall thickness of 3½ in. developing to 5 in. at edge; (3) was machined on outside face of dome; (4) alloy was DTD. 424; (5) unfettled weight was 4,000 lb., and (6) fettled weight was 3,000 lb. This casting is seen in Fig. 8.

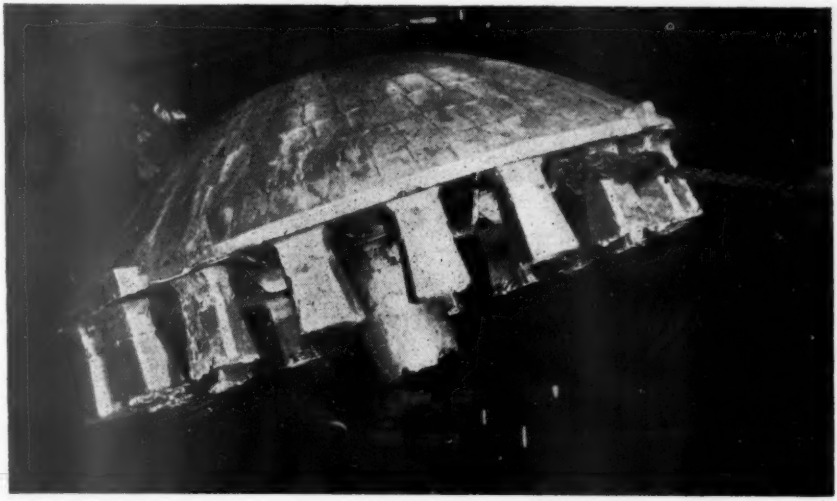


FIG. 8.—SPINNING CHUCK CASTING, 7 FT. DIAMETER, AS STRIPPED FROM THE MOULD.

Castings of this size and weight are the exception rather than the rule. It is unlikely that the founder will have either a suitable moulding box or a floor that will permit moulding and covering with a top box only. The problem in this case was, therefore, how to improvise to the best advantage by (1) substituting strickles in place of a pattern, remembering that the casting wall thickness was 3½ to 5 in., which in turn required a bottom face all chilled; (2) how to locate and secure main core to top part in a manner which would avoid the box part being turned over and, at the same time ensure that the cores and risers were correctly related to the bottom half mould.

To meet these conditions, the pattern equipment was arranged in the form of four strickles, (1)-A, to form mould and position the chills; (2)-B, to form core print for the centre core; (3)-C, to strickle facing of sand to represent wall thickness, and (4)-D, to form the ring runner bar. These and the mould arrangement are shown in Fig. 9.

Further, the sectional core box gave the main core E in ten equal parts, each core being jointed at the radial stiffening ribs. The special features in relation to this core and core box were:—(1) Frame construction

*A Paper read before the Birmingham Branch and the Slough Section of the Institute of British Foundrymen. The Authors are technical manager and chief metallurgist, respectively, at William Mills, Limited, Wednesbury.

Special-duty Aluminium Castings

which permitted ramming and drawing of the core box, using the drying plate as a base; (2) the 4-in. deep locating print through which the 6- by 4-in. risers passed, and (3) the core grids arranged with eye bolts for lifting and tapped holes for bolting them to box parts.

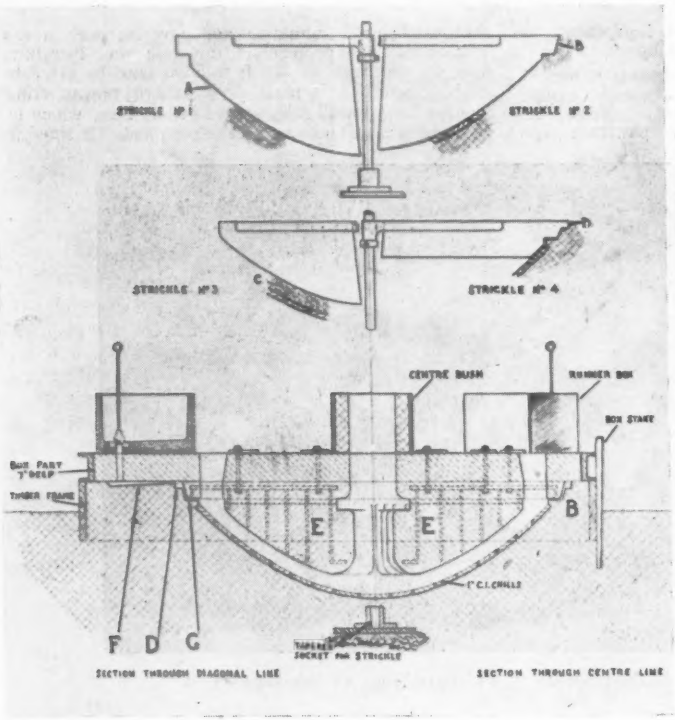


FIG. 9.—INDIVIDUAL STRICKLES AND GENERAL MOULD ARRANGEMENT FOR THE SPINNING CHUCK CASTING.

Making the Mould

The moulding box equipment consisted of a 14-in. deep timber frame in the floor and a 7-in. deep metal top part with bars suitably arranged to allow the carrying of the centre cores E and the riser cavities. The moulding procedure followed customary lines. The spindle was set up centrally and green sand rammed roughly to the casting shape. Strickle No. 1A was attached to the spindle with the top edge in line with the joint of the timber frame. The rough mould was swept to shape and the face (ultimately to carry the chills) was vented over with the needle wire. Cast iron chills were laid in position and the joints sealed. Strickle No. 2B was now mounted on the spindle arm and main core print B was cut. Floor sand representing the wall thickness of the casting was rammed on the face of the chills and cut to size by strickle No. 3C. The ten dry-sand cores E were now assembled into the mould locating into print B. The top box was lowered and its four corners staked to ensure position. The cores E were now bolted into position by inserting and tightening bolts into tapped holes in the grids. Runner and riser pegs were placed in position and the top part rammed up with care directed to avoid damaging the core edges and prints.

The completed top part was then lifted off and placed on corner supports for finishing off and placing of runner boxes and centre extension bush. The bed of sand C was then removed and print B made up and re-cut along with ring runner bar D. These operations being carried out by using strickle No. 4D.

Four gates F connecting the downgate to ring runner D, were cut by hand, one in each corner. Twenty small finger type ingates G linked the ring runner with the mould, thereby ensuring even distribution of the metal without generation of turbulence. At this stage the spindle was removed and its socket made up. The chilled face was cleaned, sprayed with oil and flamed over. The gates and ring runner were dressed and skin dried. The mould was allowed to cool, and special care was taken to close and pour before the chilled face commenced sweating. Fig. 10 shows the closing of the mould.

Over each of the ingates was a 6- by 4-in. riser and a 10-in. dia. riser bushed up twice the height of the rim risers was located in centre. Four plunger controlled runner boxes were linked with ring runner. Pouring was carried out using two ladles on two cranes and using a procession of carrying pots, for the other two pouring boxes. The metal was poured at a temperature of 690 deg. C. Feed metal was added at 750 deg. C. to compensate the shrinkage in the various risers which were rod fed.

After the casting had solidified, the bolts holding the centre section cores in the top box were removed. Later, the top box was lifted and sand was cleared from risers and top faces, allowing work to commence on easing the cores and removing the grids. An overnight period was allowed to elapse before the casting was fully stripped. Dressing and finishing were carried out in the usual manner.

It is to be noted that if more than one casting had been required, great care would have been taken in removing the casting from the mould because by clearing the spent sand around coreprint B and the gates and wetting the surrounding sand, the bottom half mould could have been re-conditioned without disturbing the chill layout apart from setting up the strickle spindle.

Preparation of Metal.

D.T.D. 424 alloy was introduced early in the recent war as a re-melt alloy. It is made from duralumin type material to which alloying elements are added, giving a type composition of 5 per cent. silicon, 3 per cent. copper, and 0.4 per cent. manganese, with various impurities. It has reasonably good casting properties and is used for a wide variety of applications. For the casting under consideration the main requirement was that there should be a minimum amount of gas in the metal, which, in the thick sections involved, would readily show up as pin-holes. This defect is a direct result of absorption and release of hydrogen. The main source of hydrogen is water vapour, and this may arise from a multitude of sources. Consequently all conditions of melting and handling were directed as far as possible to the exclusion of water vapour. In addition, de-gassing of the melts was carried out by scavenging with the reactive gases evolved from hexachlorethane applied in tablet form. A feature of the ladles used was that each was fitted internally with sheet steel linings, which obviated hydrogen pick up from any moisture present in the refractory wall.

The alloy has a freezing range (pasty stage) which avoids, in the presence of reasonable feed provision, formation of heavy shrinkage cavities, although dispersed cavitation may be experienced if feed is restricted. Under certain conditions the alloy may be sensitive to a sodium content, and minor impurities have an important effect on the shrinkage habit and mechanical properties. Consequently there is every reason to secure supplies from reputable manufacturers and to avoid picking up snap lots of metal of uncertain origin and described—erroneously—as "commercial" DTD 424.

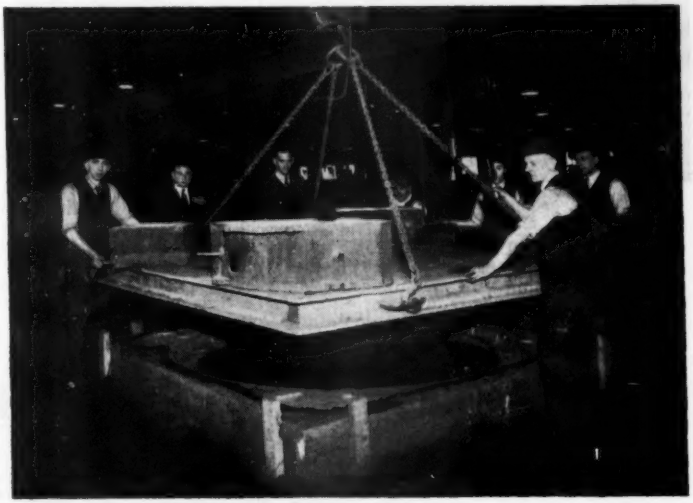


FIG. 10.—CLOSING THE MOULD FOR THE SPINNING CHUCK.

Castings of a Decorative Character for Applications in Architecture

Because of its lightness, pleasing colour, and ease of fabrication in wrought and cast shapes, aluminium alloys are extensively used in architectural and decorative applications. The panel casting described herewith is a good example of this class of work. The aluminium alloy casting, a 5×2 feet panel, was reproduced from the original, which was sculptured in plaster. This casting was fitted in the transport offices of the S.S. Queen Mary and it is shown in Fig. 11.

The foundry technique was based on the following considerations: (1) The casting had to be produced from a sculpture; (2) the alloy, when anodised, had to give a pleasing light grey or silver colour, and (3) the casting skin had to be entirely free from blemishes, as scurfing and polishing were not permitted. This relates to gating arrangements and alloy used, as metal flow marks, etc., could not be permitted.

Special-duty Aluminium Castings

B.A. 23 alloy, which meets the requirements of (2) is relatively hot short, and a carefully balanced system of gates was developed to avoid hot tears, etc. In view of the risk of scrap occurring and the obvious disadvantages of handling a sculptured plaster (mounted in a wooden frame), it was decided to produce first a metal pattern in 2.L.33 silicon alloy. The procedure enabled "stamping back" to be practised, thereby facilitating smoothness of mould surface and clear reproduction of detail.

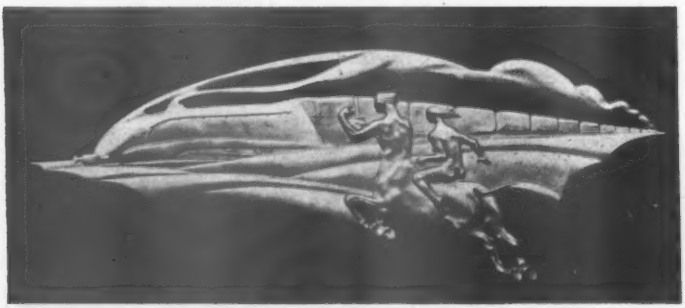
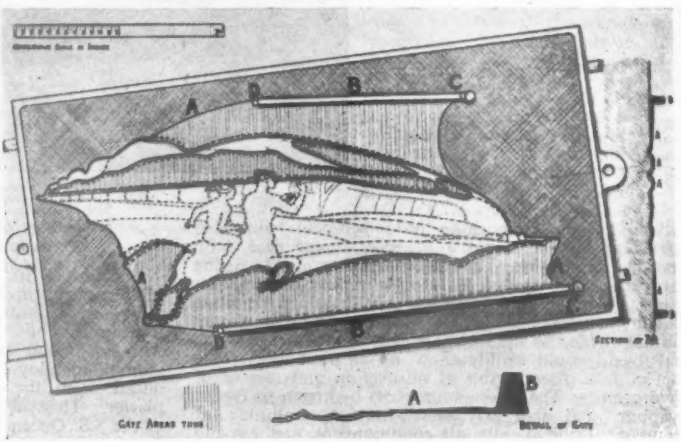


FIG. 11.—CAST ALUMINIUM-ALLOY PANEL 5 FT. × 2 FT. FOR DECORATIVE PURPOSES.

FIG. 12.—GATING SYSTEM FOR THE DECORATIVE PANEL.



Patternmaking

The pattern was produced by preparing two drag sides carefully rammed to avoid damage to the plaster. One was finished and used as part of the required mould. The other was used for ramming up the top part of the mould and then discarded. The required wall thickness was then cut off the face of the top part after turning over. The two parts were finished with a sprayed dressing and skin dried very carefully to avoid local "burning" which would destroy sharpness of detail.

After cooling off, the mould was closed and poured with 2.L.33 silicon alloy. This alloy was most suitable because of its excellent flowing power and ability to take detail. Further, its high ductility gave advantages in dressing and finishing the pattern. This casting was mounted on a board, great care being taken to avoid bruising or laceration of the face.

Moulding Procedure

Moulding procedure followed a normal course. The details are shown in Fig. 12. The pattern face was covered with facing sand and the drag was rammed up. The assembly was turned over and fixing screws removed, so that pattern remained on the drag side on

(*Concluded on page* 431.)

A Special Die-casting Method*

By E. M. H. Lips†

Machines used for charging a mould with liquid metal can be divided into two groups:—(1) Machines with a hot-pressure chamber, used mainly for low melting metals and alloys, such as lead, tin and zinc, and (2) machines with cold pressure chamber, used particularly when the metal to be handled either has a high melting point or has a strongly corrosive action upon iron and steel, so that such alloys cannot very well be passed through machines with a hot pressure chamber. Machines with cold pressure chamber are specially used for aluminium and copper alloys.

These two types of machines answer most purposes, but they have the disadvantage, amongst others, that it is hardly ever possible to get a product absolutely free of air inclusions. The liquid metal is forced into the mould in such a way that the air present at certain places becomes enveloped and compressed to a very small volume. Thus, these air inclusions are always under a pressure practically equal to the pressure under which the liquid metal is forced into the mould. Taking this pressure at about 1·2 tons per sq. in. for zinc and about 3.5 tons per sq. in. for aluminium, the air inclusions come under a stress approaching the creep limit of the metal.

*Presented at the International Foundry Congress, 1949, at Amsterdam.

†Chief engineer, N. V. Phillips' Gloeilampenfabrieken, Eindhoven, Holland.

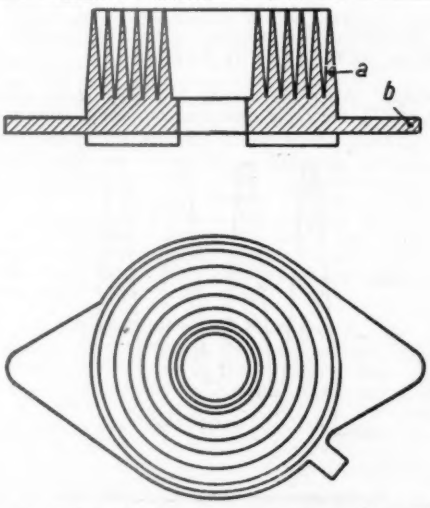


FIG. 1.—DIE-CAST HALF OF CONDENSER. EACH HALF OF THE CONDENSER IS MADE UP FROM CONCENTRICAL RINGS *a* HAVING A COMMON PLATE *b*. THE RINGS ARE CONICAL AND 0.2 MM. THICK AT THE THINNEST END.

Effect of Air Inclusions

For the normal use of die-cast parts these air inclusions are of no great consequence because they are generally very small. In the case of zinc and aluminium alloys, the detrimental effects of air inclusions become apparent when the die-casting process is followed by a heat-treatment, for instance, when zinc alloys are hot-enamelled, or in the hardening of aluminium alloys by heat-treatment. Owing to the rise in temperature of the die-cast metal, on the one hand the creep limit is reduced while, on the other hand, the stress of the air inclusion increases, with the result that the limit of elasticity is exceeded and blisters arise which often render the material useless.

This problem was accentuated when it happened that very thin-walled and accurately-dimensioned parts had to be cast for the variable condenser of an electrical apparatus. Fig. 1 details the dimensions of the cast part in question. On account of the high degree of accuracy required in the dimensions and also in view of the low mechanical stress of the cast part, after some experimentation it was decided to choose a lead alloy with about 4 per cent. antimony. The casting of this alloy with a normal machine seemed to yield satisfactory products, but after the halves of the condenser had been mounted (Fig. 2), it appeared that in course of time there was an increase in capacitance and already after a few days there was short-circuiting. An examination disclosed small blisters at the thin ends of the halves of the condenser (Fig. 3). In accordance with the theory of Frommer, the Author first tried filling the mould in such a way that the air could be completely discharged between the two halves of the mould (see Fig. 4). However, it was still found impossible to avoid the occurrence of blisters, and it was therefore decided to evacuate the mould before charging it with the liquid metal. With a normal die-casting machine the difficulties were found to be rather great, owing to the large number of seams that had to be seated vacuum-tight. After some experimentation the vacuum-die-casting machine illustrated in Figs. 5 and 6 was devised.

Description of the Die-casting Machine

In a crucible *a* filled with a molten metal or alloy *b* a pipe *c* open at both ends is immersed. The bottom end of the pipe can be made narrower by a constriction *d*. An annular plate *e* is welded on to the top end of the pipe, with a water-cooled sealing ring *f*. In the mould-holder *g* is a rubber ring *k*. The mould-holder can be connected to a vacuum pipe *via* the opening *v*. In the mould-holder is the mould *m*, held in it by a bayonet fitting. The mould itself is, as usual, in two parts. In the bottom mould are the gates *s* correspond-

A Special Die-casting Method

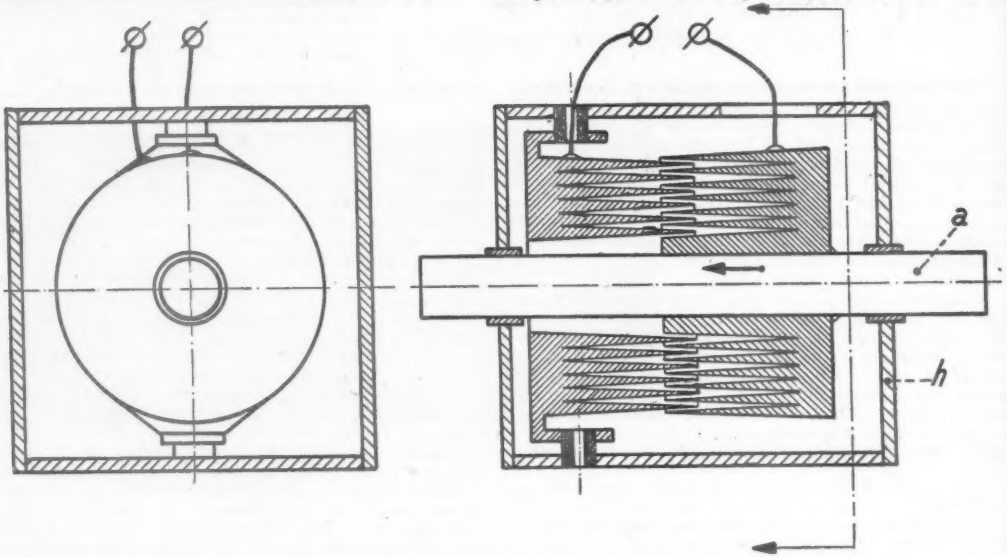


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF THE MOUNTED HALVES OF THE CONDENSER. ONE HALF IS MOUNTED ON THE CASING *h*, WHILE THE OTHER HALF IS AFFIXED TO THE SPINDLE *a*. AS THE SPINDLE IS MOVED IN THE DIRECTION OF THE ARROW, SO THE CAPACITY INCREASES.

ing to the opening in the pipe *c*. In the rim of one half of the mould a number of notches *l* have been made so that, when the two halves are clamped together, small channels are formed about 0.2 mm. high and about 5 mm. wide.

After the mould *m* has been placed in the holder *g*, the latter is pressed down on to the pipe *c*, the rubber ring *k* thereby sealing it off vacuum-tight. The opening *v* is then connected to the vacuum pipe. The air in the pipe *c* is drawn off through the channels between the halves of the mould. Liquid metal ascends through the pipe at an ever-increasing speed until the gate *s* is reached. Owing to the great velocity of the stream of liquid metal the evacuated mould is filled up, after which the metal flows also into the channels *l*. The height of these channels is such that the liquid metal solidifies in them before it can run out again. As a result the stream of liquid metal is suddenly brought to a standstill, and the kinetic energy of the flowing metal is converted into pressure. Owing to this rise in pressure, any remaining spaces in the mould are completely filled up, the pressure then rising to about 100 atm.

As soon as the metal in the mould has solidified, the vacuum pipe is removed and the mould-holder *g* disconnected from the pipe *c*. The outside air then entering the pipe from the top causes the molten metal to descend. After the casting has been removed from the mould, the cycle described can begin anew.

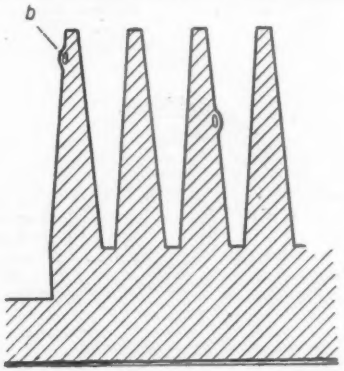


FIG. 3.—DIAGRAM ILLUSTRATING HOW BLISTERS *b* ARE FORMED OWING TO THE PRESENCE OF AIR INCLUSIONS UNDER HIGH PRESSURE.

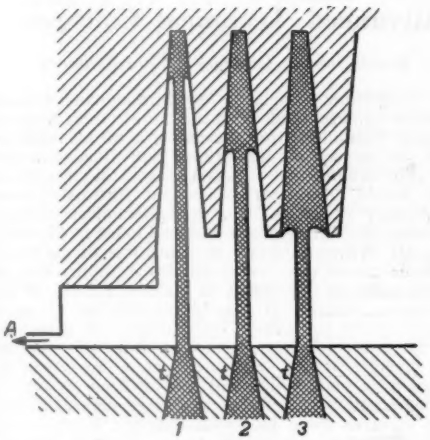


FIG. 4.—THE THREE SUCCESSIVE STAGES IN THE FILLING OF THE CONCENTRICAL RINGS IN THE CASE OF AN IDEAL CHARGE. WHEN THE MOLTEN METAL IS INJECTED THROUGH THE GAP *1* THE DIE SHOULD BE ALMOST COMPLETELY EVACUATED IN THE DIRECTION *A*.

The condenser segment cast with this machine was found to be free of blisters even after being heated for some time to 150 deg. C. The capacitance of the condenser made with these cast parts showed hardly any change with time. In order to get an idea of the pressure arising during this die-casting process, a pressure indicator was built into a special mould. This indicator was of the type in which a diaphragm seals off the pressure chamber from the atmosphere. When the pressure rises in the pressure chamber, the diaphragm bends and causes a capacitive or inductive variation, which is recorded on the screen of a cathode-ray tube. The pressure-time diagram showed that the pressure rose to approximately 100 atm., but only for the space of a few thousandths of a second. This is understandable when it is borne in mind that the mould is evacuated, and thus there is practically no counter pressure until the mould is completely filled.

Advantages and Disadvantages

The main advantage lies in the possibility of casting parts which are free of cavities under a high gas pressure, so that they can be produced with a very high degree of accuracy in dimensions. The fact that only a vacuum pump is needed and no pressure pump means that there is greater safety. It is practically impossible for liquid metal to gush out owing to negligence or defects in the system.

A disadvantage is the fact that interchangeable moulds are required, and this is only practicable for small parts. The time taken for taking out the mould and replacing it by another can be shortened by using two mould-holders placed over the ascending pipe alternately; while one mould is being filled, another can be fitted into the other holder. In this way it was possible to get about 250 shots per hour with this die-casting machine, about the same number that can be reached when using normal die-casting machines with hot pressure chamber.

In the course of time parts have been made with this machine not only of lead alloys, but also with zinc alloys of the type $Zn\text{-}Al_4\text{-}Cu_1$.

One example made was an iron core and two iron pins, which were cast together to form a part of a meter. The vacuum-die-casting machine is highly suitable for such work if the parts to be joined are of small dimensions; the pins were 10 mm. long. Attempts to

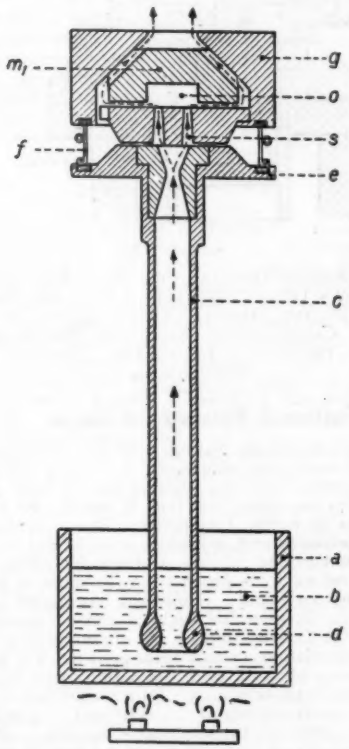


FIG. 5.—ILLUSTRATION OF THE VACUUM-DIE-CASTING MACHINE. THE ARROW INDICATES THE DIRECTION IN WHICH BOTH THE ASCENDING TUBE AND THE DIE CAVITY *O* ARE EVACUATED AND FILLED WITH LIQUID METAL.

A Special Die-casting Method

work aluminium alloys with this vacuum machine were not very successful. It appeared that the molten aluminium alloy so corroded the pipe in the crucible as to give rise to serious trouble.

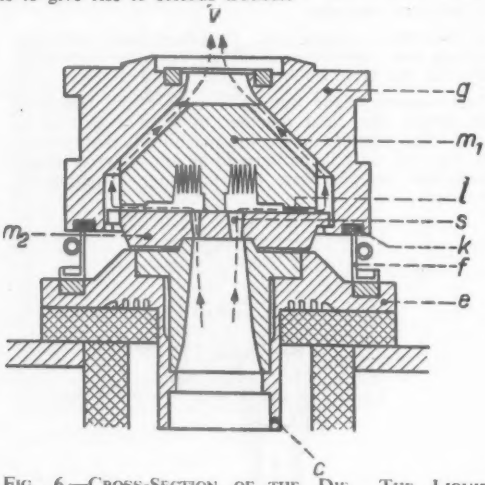


FIG. 6.—CROSS-SECTION OF THE DIE. THE LIQUID METAL FLOWS OUT OF THE TUBE *c* INTO THE DIE AS INDICATED BY THE ARROW. THE PRESSURE IN THE FILLED DIE CAVITY CANNOT RISE UNTIL THE FLOWING METAL HAS PRACTICALLY FILLED THE CHANNELS AND SOLIDIFIED.

National Foundry College

The Prospectus of the National Foundry College for 1949-50 has now been published. It is very different from—and better than—the general run of such publications. For one thing, the type is legible and there are no pages of boring time-tables. There are plenty of good illustrations and, indirectly, stress is laid on the industrial background of the College by listing the Governors and lecturers drawn from the staffs of great manufacturing companies. Emphasis has rightly been placed on the facilities for students' living accommodation at "Tor Lodge" and on the organisation of an "old boys' association." Both these activities will have the approbation of those who rate a full social life as an essential in their education. Pure technology is insufficient for the formation of character and personality. The booklet gives all the essential "business" information and a copy of it should be on the desk of every foundry owner or chief executive. The Prospectus can be obtained by writing to Mr. James Bamford, B.Sc. (head of the National Foundry College), Wolverhampton, and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

Advanced Technical Colleges

"*Revolutionary Changes*" *Foreshadowed*

Mr. J. Wilson, Principal of Birmingham Central Technical College and a member of the National Advisory Committee for Technical and Commercial Education, set up by the Ministry of Education last year, said recently that it was obvious that the Committee would at an early date put forward "some revolutionary proposals" for major technical colleges. Addressing the Birmingham Junior Chamber of Commerce, Mr. Wilson said that, as a member of the Committee, he could not reveal its deliberations, but he gave his personal impression of the future form of the Birmingham College. It would possibly be renamed the Birmingham College of Technology, and would be for advanced work only, accepting full-time students for a degree, or the equivalent of a degree, to be awarded by a body which had not yet been set up.

As the strength of a technical college depended ultimately upon its close link with industry, there would be no full-time courses as such. Instead, courses would be on a "sandwich" system, so that a student who enrolled for a full-time course would have to spend half of his time each year in industry, gaining knowledge of the processes as well as the theory of his job. In addition, part-time day or evening courses would be attended by students released from industry for one day a week.

"I am convinced," said Mr. Wilson, "that there is a place in a region like the West Midlands for a university to be dealing with the 'fundamental' scientists and technologists and for a major technical college to be dealing with the applied scientist and technologist, and for many other smaller institutions dealing with the younger groups who will feed into both these places. The deliberations that are going on in the Council will give the major technical colleges—of which there are some 20 or 30—a place in the educational system that they have never had before."

Birmingham's New College

The new Central Technical College, the building of which had begun at the top of Corporation Street, Birmingham, would be equipped "like no other technical college in Europe," with "absolutely modern" laboratories and equipment. The governing body had already agreed with him to appoint research assistants, and four would be appointed. It was also proposed to appoint a research assistant for some special investigations in steam research.

Mr. Wilson said that the Ministry of Education's permission for research to be carried out by technical college staff members during the official teaching hours had opened a new field. Formerly research could only be carried out at week-ends or in the evenings, but hours spent upon it were now regarded as teaching hours, with 10 to 12 hours a week spent on actual teaching.

Fasteners for Wooden Core Boxes

By "Checker"

Occasions arise when it is an advantage to have wooden core boxes, which are made in halves, fastened together during the process of producing cores. One essential factor with any such core box fastener is that it must be of a quick-grip and quick-release action, to save time when it is in use.

Clamps or "dogs" can, of course, often be used to hold core boxes together, but these have a tendency

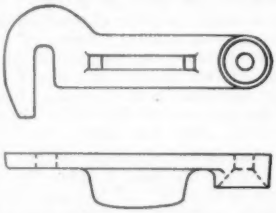


FIG. 1.—FASTENER FOR CORE BOX.

with continual use to damage equipment. A useful type of fastener is shown in Fig. 1, being made in brass or bronze, and about 3-in. overall length. They are quickly fixed in position at each end of a core box by means of a screw through the countersunk hole, and left sufficiently loose to allow an easy movement for the opposite end to swing over another screw in the other half core box. This latter screw must be left protruding the correct amount, and positioned with care

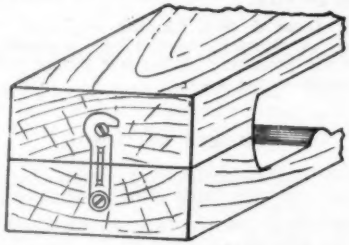


FIG. 2.—SHOWS FASTENER IN POSITION.

to ensure that both core box parts have been pulled tightly together when the fasteners are applied. Fig. 2 shows a fastener in position. Instant release or tight grip is obtained by tapping with a mallet the protruding lip which is at right angles to the core box.

Another instance in which these fasteners are useful is shown in Fig. 3; the core box on this occasion had, owing to angular interior shapes, to be made with a loose side to overcome the undercut shown. This side was dowelled to the core box body, which gave correct positioning; fasteners at each end guarantee no outward movement while ramming of the core is taking place. These fasteners can be utilised in many other ways. Core boxes having a loose top, which is inclined to lift during ramming operations, may often succ-

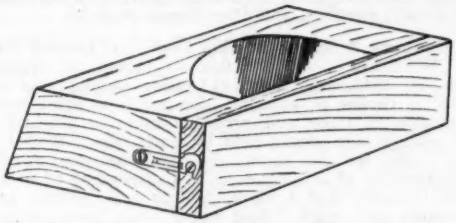


FIG. 3.—SHOWS FASTENER ARRANGED TO PREVENT OUTWARD MOVEMENT WHEN RAMMING.

cessfully be held by this method. Fasteners could, of course, be made in varying sizes to satisfy any demands for large or small work; all should have the countersunk screw-hole cast in to eliminate the necessity of machine drilling and countersinking. Fasteners should be made in both right and left hand, one of each being used on either side of a core box.

Obituary

MR. THOMAS LONGMORE, who has died at the age of 66, was a partner in Longmore Bros., manufacturers of tubes and conduits, etc., of Wednesbury.

MR. NORMAN S. HORSFIELD, who has died suddenly at the age of 67, was managing director of J. & J. Horsfield, Limited, boilermakers, etc., of Dewsbury. He had been associated with the company for 35 years.

PROF. CECIL LEWIS FORTESCUE, Emeritus Professor of Electrical Engineering, Imperial College of Science and Technology, and Professor of Electrical Engineering, Royal Naval College, Greenwich, has died at the age of 68. He was president of the Institution of Electrical Engineers in 1942.

LORD QUEENBOROUGH, who died on September 22 at the age of 58, was a former chairman of Siemens Bros. & Company, Limited, electrical engineers, etc., of Woolwich, London, S.E.18, and Submarine Cables, Limited, Greenwich, London, S.E.8, and a former director of the A.B.C. Coupler & Engineering Company, Limited, Wolverhampton.

MR. C. WALLACE SAUNDERS, who before his retirement last December had been manager of the marine department of the General Electric Company, Limited, of England, died on September 21. He was responsible for the creation of the department when he joined the company in 1918. Born in 1884 in New Zealand, and after serving an apprenticeship with a firm of general mechanical engineers, he went to sea in 1906, obtaining his chief engineer's certificate in London three years later. During his 30 years with the General Electric Company, Mr. Saunders had been closely associated with the building of a number of electrically-propelled ships.

Company News

The paragraphs below have been extracted from statements circulated to shareholders, speeches made at annual meetings, and other announcements.

Ransome & Marles Bearing Company, Limited (MR. F. W. BAKER):—For the first six months to December 31, 1948, sales were still rising steadily, but the general decline in ordering, due partly to some small recession in trade and probably more to liquidation of unduly high stocks held by users, was reflected in the sales for the second half of the year. The rescheduling of delivery dates and suspending of orders have brought out a more realistic and healthy programme and much "dead wood" has been cut out. In spite of this the sales for the 12 months were again a high record. One or two industries experienced something of a boom period after the war and the easing of their demands will now enable us to replenish our badly depleted stock and allow us to give better service both at home and overseas; this is most essential, particularly in the latter case. The board seriously considered the question of making a bonus issue, but is of the opinion that in existing circumstances no good purpose would be served by adopting this course. Although our industry has wide interests and is therefore less vulnerable than some to sudden changes, we are still subject to the general ebb and flow of trade. So far, while there is a slowing down in the demand from certain industries, others are still increasing and express considerable optimism, and the demand at the present time is still several times the pre-war level. Currency difficulties, import licence restrictions, labour troubles in far quarters of the world affect not only our own trade, but our customers' as well, and we must hope that the present efforts being made to solve the international problems in Europe and America will meet with success. If the present level of consumption continues among the main industrial users and no further international obstacles are created to restrict both our direct and indirect exports, we should be able to keep production at a level sufficient to earn a reasonable profit.

Qualcast, Limited, light repetition steel and iron founders, etc., of Derby:—The directors propose a scrip bonus of 100 per cent. The issue has been approved by the Capital Issues Committee. The authorised capital is to be increased from £325,000 to £575,000 by the creation of 1,000,000 5s. ordinary shares, and £169,918 15s., part of the share premium account, is to be applied in paying up in full 679,675 unissued ordinary shares which will be distributed as bonus shares in the proportion of one new for each 5s. ordinary share held.

G. N. Haden & Sons, Limited, heating and electrical engineers, of Trowbridge, Wilts:—Owing to unfavourable marketing conditions, the directors have, for a second time, postponed their projected issue of preference shares. Further, the rate of interest and rights originally defined for the shares are to be cancelled. (Three months ago the company created 350,000 5 per cent. £1 preference shares, of which 250,000 were to have been issued to finance increased costs and turnover.)

Metropolitan Gas Meters, Limited, Nottingham:—An issue is being made of 55,000 2s. ordinary shares to Philblack, Limited, in consideration of the transfer by that company to Metropolitan Gas Meters of 5,000 £1 ordinary shares in Cheltenham Meters, Limited. The new shares will rank *pari passu* with the existing shares except that they will only be entitled to one-quarter of the dividend to be declared in respect of the year to September 30.

Wm. Neill & Son (St. Helens), Limited, industrial plant engineers, etc.:—The sum of £20,000 (part of £25,000 share premium account) is to be capitalised by paying up the 200,000 unissued ordinary shares of 2s. for distribution among shareholders registered September 30 on the basis of one share for every four held. The new shares will not rank for the final dividend in respect of the year ended March 31, 1949, but will rank for dividends after that date.

Acrow (Engineers), Limited, Northwood, Middx:—Application is to be made to the London Stock Exchange for permission to deal in and for quotation for 200,000 5½ per cent. cumulative preference £1 shares. The total authorised and issued capital of the company amounts to £300,000, the balance being in ordinary 5s. shares.

Allen West & Company, Limited, switchgear manufacturers, etc., of Brighton:—Permission is being sought from the Capital Issues Committee to capitalise £365,625 of reserves for a bonus distribution of three 5s. ordinary shares for every five 5s. units of ordinary stock held. This would make the issued capital of the company £975,000.

W. H. Dean & Son, Limited, engineers, foundrymen, etc., of Burnley (MR. W. F. ANDREWS):—The directors are proposing to increase output by further developments in the works.

Changes of Name

The following companies have recently changed their names, the new titles being given in parentheses:—

LONDON METAL PRODUCTS, LIMITED, Ilford (Cottage Laboratories, Limited).

CHAIN DEVELOPMENTS, LIMITED, West Bromwich (Hills' Chain Company, Limited).

H.W.B. ENGINEERING COMPANY (DARLASTON), LIMITED (Stanley Horne & Sons, Limited).

BANCROFT ENGINEERING COMPANY, LIMITED, Luton (Bancroft Folding Machines, Limited).

Mr. H. M. Garner, who for the past three years has been Principal Director of Scientific Research (Air) in the Ministry of Supply, has been appointed to succeed Sir Ben Lockspeiser, now Secretary to the Department of Scientific and Industrial Research, as Chief Scientist of the Ministry.

Special-duty Aluminium Castings

(*Continued from page* 424.)

removal of the plate. The joint was prepared and ingates A ($\frac{1}{16}$ in. thick at the junction with casting), inclined downgates C, runner bar B, and riser D were placed in position on the mould. The top part was closed on and ramming was completed. The mould was parted and the pattern refixed to the plate and withdrawn from the mould, using box pins as guides. The top part, which included the gates, was finished by spraying and skin drying. In the case of the drag, where exact reproduction of the pattern was all important, the required finish was obtained by first dusting with French chalk. This was followed by a further dusting with a fine-grain sand and "stamping back" the pattern.

The purpose of the fine sand was to give body to the coating and prevent the chalk picking up on the pattern face when "stamped back" into the mould. The casting was run from both sides with the thin gates A connecting into one piece the pierced sections of the panel. This arrangement made the casting into a plate, thereby strengthening the fragile areas of the panel during solidification and cooling. This gating involved considerable dressing, but the gates, being thin and attached to the back face of the casting, were removed without danger of marking the face. The runner bars B and adjacent part of ingates were of reduced section to prevent flow marks extending past the gate area.

The casting was poured at about 730 deg. C. After cooling, the outer gates were removed by sawing and the inner gates by chisel. Filing of the edges followed, and the face of the casting was lightly brushed with a high-speed 4-in. dia. soft wire brush. This operation cleaned the surface and removed the mould stains without breaking the skin or reducing detail. The finished casting was then anodised.

Preparation of Metal

The anodising process is most searching in its effect on the surface. It reveals any surface blemishes, local porosity or cracks very readily. In fact, the process has been used as an inspection method for detection of surface defects in light-alloy forgings. Consequently uniformity and smoothness of surface was vital. Hence the care taken at the moulding stage.

Unfortunately, as the alloy content increases in aluminium, the tendency of the surface to turn grey or dark on anodising also increases. Usually the casting properties improve as the alloy content increases. This holds for all cases except for the binary alloys in which magnesium is the alloying element. The alloy used was B.A. 23, which contains 1.5 per cent. magnesium and 0.6 per cent. silicon. It was prepared by careful melting under "Hanson Slater" flux in oil-fired crucibles. Degassing treatment was not considered necessary. On anodising, this material gives a pleasing film without dark shading, etc.

Acknowledgment

In conclusion, the Authors tender thanks to William Mills, Limited, for permission to publish details of the work to which reference has been made, to colleagues for the help they have given in the preparation of the Paper, and to Mr. N. Pearson for his assistance in preparing the drawings.

Publications Received

The Foreman and Production Control. Published by the Institute of Industrial Supervisors, Bank Chambers, 47, Temple Row, Birmingham, 2. Price 2s. 6d., post free.

This is quite a good pamphlet—it run to 20 pages. By means of three clear diagrams, and an assembly of numbered or lettered short paragraphs, a really worthwhile system of control is disclosed. The method will require still further simplification for the smaller works, that is, for those concerns placed intermediately between the type where one man has everything "under his hat" and the larger fry.

Report for the year 1947-48, with a review of the years 1938-48. Issued by the Department of Scientific and Industrial Research. Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 2s.

This report shows that the total gross expenditure by the Department has risen £682,180 in 1939 to £2,694,061 in 1948. These figures are indicative of the growth of the Department, the work of which to day penetrates nearly every industry, and a perusal of this report is of real interest in disclosing what has been and is being done to make the whole country aware of the benefits to be derived from co-operative research. The Report runs to just over 100 pages and carries five useful appendices, the first of which lists the personnel of the various committees, and the last, the expenditure of the Department. Another lists the various research associations, with appropriate data. Altogether it is an interesting document covering an activity of a Government department insufficiently appreciated by the man-in-the-street.

Metal Industry Handbook and Directory. Published by the Louis Cassier Company, Limited, Dorset House, Stamford Street, London, S.E.1.

This 1949 edition is, like the earlier ones, divided into four main sections:—(1) General properties; (2) general data and tables; (3) electro-plating, finishing, galvanising and anodising, and (4) directory. Then, each section is suitably sub-divided to include the appropriate information. In section I, for instance, the listing of the trade-marked alloys is distinctly useful. The nature of the other sections is clearly shown by their titles. The book now runs to 475 pages and is of real value to makers and users of non-ferrous metals and alloys.

Company Results

(Figures for previous year in brackets.)

FERRANTI—Dividend of 6%, tax free (same).

GLYNWED TUBES—Interim dividend of 12½% (same).

STEDALL & COMPANY—Interim dividend of 7½% (same).

CROSSLEY BROS.—Final dividend of 8½%, making 12½% (same).

CROSSLEY-PREMIER ENGINES—Dividend of 12½% (same).

HORSELEY BRIDGE & THOMAS PIGGOTT—Dividend of 15% (same).

BEDE METAL & CHEMICAL COMPANY—Interim dividend of 6¼% (same).

TELEGRAPH CONDENSER COMPANY—Interim dividend of 5% (same).

BRUSH ELECTRICAL ENGINEERING COMPANY—Interim dividend of 4% (nil).

IMPERIAL CHEMICAL INDUSTRIES—Interim dividend of 3% (same on smaller capital).

WILLIAM DOXFORD & SONS—Final dividend of 10% and bonus of 5%, making 20% (same).

BIFURCATED & TUBULAR RIVET COMPANY—Interim dividend of 11%, tax free (two interim payments of 2¾%, tax free).

ELECTROLYTIC ZINC COMPANY OF AUSTRALASIA—Final ordinary dividend of 8%, making 15% (same), plus bonus of 10% on both ordinary and preference shares (nil).

ASSOCIATED BRITISH ENGINEERING—Interim dividend of 6% (nil). The directors state that the payment of an interim dividend does not imply any increase in the total for 1949-50.

SHEFFIELD FORGE & ROLLING MILLS COMPANY—Final dividend of 10%, making 15% (same). The capital distribution of 8d. per 6s. 8d. share, or 10%, paid in 1948, is not repeated.

W. H. DEAN & SON—Trading profit to August 17, £106,874 (£127,530); other income, £2,217 (£2,333); to depreciation, £7,484 (£6,669); directors' remuneration, £7,293 (£6,944); profits tax, £16,750 (£18,442); net profit, £77,564 (£97,808); to income tax, £36,738 (£43,872); general reserve, £16,700 (£20,000); dividend equalisation reserve, nil (£10,000); dividend of 50% (same); forward, £24,476 (£24,000).

KAY & COMPANY (ENGINEERS)—Trading profit, incorporating subsidiary for the year ended May 31, £224,133 (£153,549); investment income, £265 (£827); directors' remuneration, £5,850 (£5,900); auditors' remuneration, £200 (£131); depreciation, £22,892 (£17,360); tax, £118,238 (£87,074); net profit, £77,218 (£43,911); brought in, £25,422 (£21,626); to bonus and provident funds, £1,000 (same); general reserve, £40,000 (£22,012); written off goodwill, £16,863 (£5,000); dividend of 20% (same); forward, £32,677.

LONDON TIN CORPORATION—Dividends from investments, and interest to April 30, £420,568 (£262,026, plus sundry net profits on realisations £4,042); to directors' emoluments, £2,700 (same); administration and other expenses, £24,373 (£21,135); tax deducted from dividends, less amount recovered, £151,629 (£76,644); mining projects, expenditure and share interest written off, £18,404 (nil); net profit, £223,462 (£165,589); dividend of 8% (6%); general reserve, £125,000 (nil); forward, £175,833 (£236,573).

AURORA GEARING COMPANY (WILMOT NORTH)—Net trading profit for the year ended June 30, £43,881 (£32,904); other income, £183 (£174); to directors' emoluments, £5,798 (£4,265); depreciation, £965 (£861); auditors' and registrars' fees, £240 (£100); profit, before tax, £37,061 (£27,852); to tax, £20,461 (£12,323); dividend payable prior to reconstruction, £1,418; final dividend of 33⅓%, making with the interim on former capital (equivalent to 5⅔% on present capital) 39%. The company was made public in April last.

STOTHERT & PITT—Consolidated profit, before taxation, for the year to June 30, £472,805 (£317,461); taxation, £232,726 (£166,504); net profit, £240,079 (£150,957); parent company's net profit, £220,492 (£138,162); special bonus to employees, £18,000 (same); re-equipment reserve, £75,000 (£25,000); general reserve, £20,000 (£56,985); contingency reserve, £50,000 (nil); dividend equalisation reserve, £30,000 (nil); dividend of 10% and bonus of 5% (same); forward, Stothert & Pitt, £79,585 (£79,037); consolidated carry-forward, £136,557 (£119,625).

NEEPSEND STEEL & TOOL CORPORATION—Consolidated trading profit to March 31, £528,649 (£459,430); other profits and receipts, including interest and dividends, £11,115 (£10,570); brought in, £386,703 (£264,434); to welfare fund interest, £412 (same); tax, £281,282 (£235,498); general reserve, £25,555 (£26,000); welfare fund, £5,000 (nil); final ordinary dividend of 15% and bonus of 20%, making 50% (same); additional dividend of 4% (same) on the 6% participating preference shares; forward to parent £28,328 (£25,336), to subsidiaries £500,069 (£361,368).

WALKER BROS.—Trading profit for the year ended March 31, £39,301 (£28,884); interest, £46 (£103); deferred repairs claim allowed by Ministry, £4,060 (nil); to directors' emoluments, £5,951 (£4,266); auditors' fee, £300 (same); trustees' fees, £252 (same); depreciation, £2,199 (£2,137); debenture interest, £1,611 (£1,720); balance, £33,094 (£20,312); to tax, £18,695 (£10,170); preference dividends, £1,927 (£2,117); maximum ordinary dividend of 7% (same); debenture redemption fund, £2,388 (£2,280); reserve against fall in stock values, nil (£4,975); provision for obsolete plant, £9,314 (nil).

RANSOME & MARLES BEARING COMPANY—Balance from trading account for the year ended June 30, £729,806 (£745,939); dividends and fees, £1,016 (£213); accumulated overseas balances agreed, nil (£7,097); to directors' emoluments, £20,633 (£19,850); estimated profits tax, £87,000 (£90,000); income tax, £222,000 (£255,000); depreciation, £100,006 (£101,145); auditors' remuneration, £696 (£706); net profit, £300,487 (£286,548); final dividend of 12½% (same on smaller capital and bonus of 5% (same on smaller capital), making 25% (same); to general reserve, £150,000 (£142,414); pension fund trustees, £10,000 (£40,000); directors' remuneration, £3,000 (same); forward, £116,253 (£84,641).

WILLIAM JACKS & COMPANY—Group trading profit for 1948, £292,702 (£220,455); other income, £14,510 (£12,417); to depreciation, £5,161 (£4,865); directors' emoluments, £25,611 (£16,825); London staff co-partnership bonuses, £15,209 (£19,101); audit fees, etc., £2,229 (£1,966); expenses of conversion to public company and Stock Exchange quotation for ordinary, £8,210 (nil); off goodwill, nil (£1,000); U.K. profits tax, £27,000 (£24,000); Dominion profits tax, £18,500 (£14,000); U.K. and Dominion income tax carried to revenue reserve, £104,500 (£76,372); profit, £100,792 (£74,743); dividend on increased capital of 25% (22½%); stock reserve, £15,700 (£11,205); tax contingencies reserve, £24,000 (nil); general reserve, £20,000 (£45,000); forward, £30,387 (£28,516—less £13,000 provision for further Dominion taxation on previous year's profits).

"Rust" on the Air

"Rust" was the subject of a half-hour unscripted discussion broadcast from the corrosion laboratory of the British Iron and Steel Research Association at Birmingham on Tuesday. The great economic importance of the problem was emphasised and listeners were given a description of the Corrosion Committee's fight against rust.

Dr. Hudson, leader of the laboratory, and Mr. G. P. Acock, a member of the staff, were joined in the discussion by Mr. T. M. Herbert, research director of British Railways. Dr. J. W. Jenkin, director of research, Tube Investments, Limited, Mr. F. Fancutt, paint technologist, British Railways, and Mr. G. Smith, of Alfred Holt & Company, Limited (Blue Funnel Line).

Light Castings for Vitreous Enamelling*

By H. McNair†

It has been decided to synchronise the re-introduction of our regular feature devoted to the Vitreous Enamelling Industry with the holding, in Birmingham, of the 15th Annual Conference of the Institute of Vitreous Enamellers.

Introduction

It is intended here to take the term "light castings" as iron castings related to the production of gas and electric cookers, solid-fuel-fired ranges, etc., where the casting weighs from 1 to 50 lb., and where the sections are consistently between ¼ in. and ¼ in. The vitreous enamelling of such castings has been normal practice for many years, and over this period great improvements have been made in the quality of enamels used and in the technique of their application. Foundry practice also has advanced considerably, but even to-day the opinion is held that, in general, the quality of light castings falls short of the exacting requirements of the vitreous enamelling industry. This is due mainly to three factors:—

(1) A gradual changeover from non-acid-resisting to acid-resisting enamels, which, admittedly, are more difficult to apply; (2) a decline in the use of ground or grip coats, particularly of the matte type (this decline can be attributed to the fear of poor adherence of such coats), and (3) the demand for enamels in self colours, particularly white and pastel shades.

Whilst the term "exacting requirements" has been used, this is only meant to be true by comparison with those of over 20 years ago. Then, the bulk of cast-iron enamelling was of the grey- and white-mottle type, a large proportion of it in sponge mottle, and by the very nature of the finish, a great many defects, such as "boiling," fine pinholing, surface ripple, bare edges, etc., were masked. The standards of to-day will not tolerate these defects, and in listing them and calling for a higher standard of casting, the vitreous enameller is making no apologia for bad enamelling, but rather an appeal for a more sympathetic understanding of his difficulties.

In using the term "enamellability" the vitreous enameller asks for castings which will meet certain requirements during processing, and it is these requirements and the satisfying of them which it is proposed to discuss.

Enamelling defects which may be fairly attributed to faulty casting production are:—warping, cracking, "boiling," local blistering or "boiling," and burning-off on edges. It is on the responsibility for the avoidance of these defects that disagreement generally arises. When a casting cracks or warps, is it the responsibility of the enameller, the ironfounder, or the designer? The same question can reasonably be asked about the other defects mentioned, and a study of all the factors involved is essential, before agreement upon, and a solution to, each problem is reached.

Metal Composition

A typical range of composition for the class of work under consideration is suggested:—

	Per cent.
Total carbon	3.0 to 3.3
Silicon	2.6 to 3.0
Manganese	0.5 to 0.7
Sulphur	0.07 to 0.1
Phosphorus	0.9 to 1.4

The constituents by which the foundryman has been accustomed to control his day-to-day run are silicon and phosphorus, the former because of its influence upon graphitisation and the latter for its fundamental effect upon fluidity. Silicon, however, is the more important of the two, and from the wide range of compositions employed in ironfounding and the great variety of physical and mechanical properties obtained from low-, medium- or high-silicon irons, its importance can be gauged.

Silicon.—It is customary to use as a basic constituent in the cupola charge a pig-iron with a silicon content of about 3.0 per cent., and a typical charge would be: pig-iron 65 per cent. and foundry scrap 35 per cent. In melting, however, about 5 per cent. silicon is lost through oxidation, and, in the case

*Presented at the Annual Conference of the Institute of Vitreous Enamellers at Birmingham.

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quoted, the net loss would probably be 0.15 per cent., *i.e.*, the pig would drop from 3.0 to 2.85 per cent. and the scrap from 2.8 to 2.65 per cent. Whilst a high silicon content in the melt will, by its graphitising influence, assist the foundryman to avoid a chilled or mottled structure in the castings and to a certain degree improve fluidity, it has additional influence. A figure of 4.3 per cent. carbon is accepted as the eutectic composition value for iron carbon alloys and each 1 per cent. silicon added to the alloy reduces the carbon content of the eutectic by 0.3 per cent. A silicon of 2.8 would accordingly drop the carbon value of 0.8 to 3.5. If, however, there were any carbon pick-up in the cupola (and generally there is a small and variable amount), this carbon in excess of the eutectic or theoretical value will be deposited from the melt on cooling and will further increase graphitisation. Silicon, therefore, has a twofold effect, first by inherent graphitising, and secondly by its control of the eutectic carbon value.

Phosphorus.—Phosphorus, on the other hand, appears to affect the eutectic value only and itself has no graphitising properties. Its effect on the eutectic is somewhat similar to that of silicon, *i.e.*, increased phosphorus will lower the theoretical carbon value, and any excess or hyper-eutectic carbon will be precipitated as graphite on cooling. It is, therefore, only a graphitiser in a secondary manner.

Phosphorus exists in grey iron as iron phosphide, Fe_3P, and has the effect of lowering the melting point of the eutectic iron carbon alloy by some 27 deg. C. per 1 per cent. P. Its influence upon fluidity, however, is even greater, because it converts the eutectic to an alloy with a freezing range instead of a single melting point. This range is from 1,073 to 950 deg. C., and it is this result which is mainly responsible for the valuable property of fluidity possessed by phosphoric irons.

Whilst it has already been stated that phosphorus will only influence the iron carbon eutectic, it has an effect upon the condition of the carbon because of this property of increasing the fluidity. The relatively longer time taken for the solidification of phosphoric irons has the effect of lowering the combined carbon, and therefore lessens the tendency to produce chilled or mottled iron. The phosphide constituent, however, is in itself of a brittle nature and, other things being equal, an increase in the phosphide constituent will have an adverse effect on the strength of the metal. It is therefore advisable, where freedom from brittleness and weakness is desired, to keep to the lowest possible phosphorus content consistent with obtaining sufficient fluidity.

Manganese.—Theoretically, the presence of manganese in cast iron has the effect of reducing the combined carbon, and therefore it has a softening influence. This is contrary to the view often expressed by foundrymen, who are perhaps mistaken by its ability to promote soundness. It is the accepted view that the manganese content should be, as a minimum, 0.3 + (1.73 × sulphur content) per cent. If this condition be met, the sulphur is then regarded as being in the insoluble form, in which condition it is without influence on the state of the carbon and can exert none of the chilling effect so well known. Manganese, therefore, by its effect in cancelling out the carbide-promoting effect of sulphur, is a valuable softener. Whilst it increases the shrinkage slightly, this is not sufficiently marked to be of importance, but it undoubtedly exerts a valuable influence on the soundness and to a lesser degree on the fluidity of the metal. All these properties, *i.e.*, increased shrinkage, soundness and fluidity are related and indicate that it is advisable to keep above the theoretical figure already mentioned, and, indeed, to work with a manganese around 0.6 to 0.65 per cent. Experience has indicated that, other factors being constant, a high manganese will give a stronger iron and much reduced warping and cracking.

Sulphur.—This constituent occurs in commercial cast iron as the sulphides of iron and manganese. As previously mentioned, its condition in the metal is determined by the amount of manganese present. If the latter is absent, sulphur up to 0.9 per cent. can exist as FeS, a constituent which is soluble and evenly distributed in the mass, and which, as previously stated, prevents the formation of graphite, and hence gives rise to chilled or hard castings. If these conditions exist, then the shrinkage will probably increase and the solidification period will be shortened. This latter factor will naturally favour the entrapping of gases which are evolved during cooling and may, in fact, be the cause of blowholes.

If, however, sufficient manganese be present to form MnS (as already described), then the chilling or hardening effect of sulphur is counteracted, and graphitisation can proceed as far as the other controlling constituents will allow. It is of value to note that MnS is insoluble in the mass and, being of a comparatively low specific gravity, will, under favourable conditions, segregate to the top of the casting. This, however, is only likely to occur in castings of heavy section and little or no sulphide segregation will occur in castings of the type under consideration.

Should the sulphur content or its distribution be under suspicion, however, the old and well-tried method of taking sulphur prints is still of value as a fairly rapid method of examination. These prints are obtained by impressing acidified "bromide" paper on the surface of the casting to be examined. It is necessary to clean this surface previously by rough polishing and by washing with methylated alcohol.

From these considerations it can be seen that sulphur within the limits already specified, will have little or no influence upon the structure or enamellability, provided the iron sulphide constituent is absent and that manganese is present in sufficient quantity to ensure the formation of manganese sulphide.

Cupola Practice

The influence of the constituents having been considered, it is necessary next to consider the effect of such factors as method of cupola operation and casting

temperatures, as these can affect to a marked extent the ultimate composition and the structure.

If the necessity for conforming to a standard composition is recognised, then every effort to keep within close limits is well repaid. In cupola operation, the aim should be to melt at an even speed and temperature and this will be assisted by maintaining a constant size of charge materials, and by insisting on keen weighing of all materials.

It is undesirable to be too ambitious where metal-to-coke ratios are concerned and a satisfactory level for melting is 10:1. This does not include the bed coke. Any attempt to economise on this ratio may be partially successful, but is more likely to mean a steady burning away of the bed coke to a minimum, *i.e.*, a lowering of the melting zone, followed by a drop in metal temperature. This will be accompanied by a drop in total carbon and, if conditions be severe (*i.e.*, oxidising), a higher silicon loss than normal will be experienced. As already emphasised, these are conditions which will immediately upset the constitution of the resultant cast iron, and may well lead to difficulties at a later stage.

A further, if somewhat obvious, factor in maintaining constancy of composition, is the relation between the metal charge and the amount of molten metal the cupola well will hold. The well should be capable of collecting at least two complete charges, and these should never be completely tapped out during a run. If the charges are large, and the well small, variations in both temperature and composition will result.

Whilst there is still a diversity of opinion upon the effect of "foreign" scrap in the charge, there is general agreement that it should be at least of a reasonably uniform size and section, and more important still, it should not be heavily rusted and oxidised as is only too frequently the case. The use of rusty scrap in any quantity must inevitably create oxidising conditions in the cupola, with a resultant higher silicon loss and a drop in the carbon pick-up. If, however, the scrap be properly graded and clean and its composition known, then small amounts can safely be included in the metal charge.

Effect of Melting Flux

Another important cupola factor is the flux, and it is interesting to note how widely this charge varies between foundries. Limestone or calcium carbonate is in general use, although calcium fluoride is occasionally chosen, principally because of the more fluid type of slag formed. The main function of the flux is to remove the non-metallic impurities, in particular the ash of the coke and the sand and scale of the metal charge. With this in mind, it is obvious that a knowledge of the ash content of the coke is necessary before deciding on the weight of flux to be added. Similarly, heavily-sanded pig and scrap must be taken into consideration when determining the flux to be charged. It is generally accepted that the lime content or CaO in the final slag should be about 30 per cent. at which figure the slag is fluid and maximum de-sulphurisation will occur. This de-sulphurisation is an important factor, as the ash of the fusion zone coke can often be high in sulphur, and if the limestone charge is light, this will mean a high sulphur concentration in the slag. As the ratio of sulphide in the slag to the sulphide in the metal is a constant, any increase of sulphide in the slag results in a transfer of sulphide to the metal to maintain the constant value. Thus the sulphide in the metal may be increased, with a consequent disturbance of the constitution of the cast metal.

It is therefore important to pay as much attention to the flux and the degree of cleanliness of the charge materials as to the composition of the metal charge, and not to assume, having determined the coke and flux charges, that these can safely be left to run at constant figures. Any serious increase in impurities, whether as sand on the pig, oxide on the scrap, or ash in the coke, calls for a readjustment of the fluxing conditions. As a general recommendation, the slag should be approximately a lime/silicate $CaOSiO_2$ type with approximately 30 per cent. CaO and should be fluid and hot for easy removal. This physical condition of the slag is not to be ignored, as nothing can so easily cause scrap in enamelling as the presence in the metal of slag in the brittle and finely broken-up form. Despite every precaution in the container, bogie or hand-ladle, these particles of slag will generally find entry to the mould, and be revealed at the shot-blasting stage of the enamelling process as inclusions or holes, both liable subsequently to result in blistering or boiling.

A factor which promotes this irritating condition, is the dirty state of the containers and hand-ladles. A skull of slaggy, oxidised metal on the latter will inevitably lead to the conditions so well known in the foundry, where the metal is in constant ebullition with the throwing-up of the particles of oxide and slag already mentioned. Insistence on daily attention to bogies and ladles is therefore of vital importance, and the use of skimmers, teapot ladles, and indeed any suitable method of slag removal, is to be wholeheartedly encouraged.

Moulding Sands

Any attempt here to give this subject the time and attention it merits would be inadequate, as it is surprising how variations in moulding sand and in particular facing sand, can give castings of widely different enamellability. A vast amount of literature is available on the subject, dealing with all classes of castings, but for castings to be enamelled, it is probably correct to assume that the emphasis should be on facing sand, *i.e.*, sand prepared for application to the pattern surface which should produce a casting free from fused-on sand, sand-wash marks, and surface irregularities in any form. Refractoriness, strength and permeability are therefore all required, though probably not to the same degree as in other and heavier classes of work. The ability of a sand to strip cleanly from the casting and leave a fine surface free from blemishes should be the major aim. To achieve this, it is usual to mix or mill finely powered coal dust into a chosen natural sand. Whatever has been said elsewhere with regard to the effect of coal dust upon permeability and strength, its function is to produce easy stripping and a fine surface.

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As this is done by the evolution of the hydrocarbons or gas when the mould is cast, the degree of fine finish obtained becomes a function of the nature of the coal dust, its fineness of grinding and the amount present in the facing sand. As the volatile constituent is so important, a regular check on deliveries of coal dust should be made in the form of a proximate analysis, indicating the volatile and ash percentages. This volatile constituent should be in the region of 30 to 40 per cent. and the ash as low as possible, preferably around five per cent.

Importance of Volatile Matter

In the determination of the volatile matter in the laboratory, it is of value to note the nature of the button of coke remaining, as this gives an indication of the physical condition of the coal-dust residue in the facing sand after casting. A suitable coal dust will generally form a button of porous coke, and the degree of swelling and porosity is a guide to the quality and indeed to the volatile content. A coal which swells and cokes is generally high in volatile constituent, and *vice versa*. The quality of the coal dust is, of course, only of initial importance and its value will only be realised by intimate mixture in the correct amount in the sand. It is not sufficient to fix the quantities of new sand, return sand, and coal dust in the mixture and assume this will give a constant quality of facing sand when milled, particularly if dealing with a foundry in which floor-moulding is practised. The return sand carries a proportion of unused coal dust, and this can vary to a very large extent, and exert a substantial influence on the volatile content of the final facing sand. It is this factor which is the determining one, and therefore worthy of control. Regular determinations of volatile constituent in the milled facing sand are therefore necessary, if uniform conditions are to be maintained. The strength of facing sand required, as determined by the volatile content, is obviously a matter to be decided by the average weight, area, and section of castings being made, and it is therefore advisable to keep a stock of two, three or more facing sands for use upon the various weights and sections of casting, and to insist upon their being used.

Having provided a suitable facing sand, it may still be found that results are variable, as shown by casting finish and by enamellability. This quite frequently occurs, and in a large foundry some time ago, led to a lengthy examination of facing sand use as related to enamellability. Information was collected over an extended period, showing the quantities of facing sand used by individual moulders on similar and comparable castings, and the enamelled products from their castings. Obviously, those factors alone cannot be taken as conclusive, but the results were illuminating; they showed that individual moulders use widely different amounts of facing sand, but the point of main interest was that best enamellability was obtained from castings where the greatest quantity of facing sand was used. The quantities varied from 1¼ to 3¼ cwt. per day per moulder and at this latter figure good enamellability was established. This observation is mentioned to emphasise that proper facing sand alone is not sufficient—its proper use in adequate quantity is necessary. Good supervision alone can ensure that this latter provision is fulfilled.

The foregoing conditions will ensure the production of castings with a fine surface, distinguished by a very definite deposit of carbon. The presence of this carbon deposit appears to be of advantage in promoting enamellability, although it is more likely that it is the layer of coal gas formed during casting which is the effective factor, and that the carbon deposited on cooling is the normal residue from such a condition in the mould. It is certain that such a film of gas evolved during pouring of the mould will create a condition under which it is difficult to conceive that erosion or fusing of the sand surface can occur. It will, in fact, promote a condition consistent with mould refractoriness; this must have an effect in the direction of chill elimination and graphite promotion and be, therefore, of benefit.

The Holley Carburetter Company used a similar principle some years ago in the United States, when, to arrest the formation of carbide or chill, and to lengthen the life of their permanent moulds, they used a final surface coating of carbon from an acetylene flame.

Worm Marks or Rat-tail Defects

There is a defect which occurs in light castings, known as "worm mark" or "rat tail" or "seam," which occurs as a shallow rut, generally on flat castings such as hobs. The rut may extend from both ends of the runner over the surface of the casting from two or three inches to a foot or more in length. These ruts may scarcely be noticeable on the casting, but, when it is enamelled, particularly in black or some of the darker colours, they appear exaggerated and spoil an otherwise smooth vitreous finish. This defect appears to be related to the physical properties of the moulding sand, particularly to permeability and the expansion of the sand when the mould is cast.

Some time ago, in a light-castings plant, a particularly troublesome spell of this defect led to a general examination of various types of facing sand and revealed the following points:—

(1) Whilst fine- or small-grained sands were particularly prone to give this defect, relatively coarse sands were not entirely free.

(2) The degree of milling and development of the clay bond had no positive effect on the problem.

(3) Increasing the volatile constituent by adding coal dust had a beneficial effect and considerably reduced the occurrence of the defect.

(4) Substituting wood sawdust for coal dust could eliminate the defect entirely and gave quite a suitable facing sand.

(5) Additions of silver sand or sharp sand, *i.e.*, almost pure sand without a clay bond, exaggerated the condition. Increasing the quantities of sharp sand up to 50 per cent. resulted in the occurrence of

severe defects which were no longer "ruts," but rather sharp breaks in the surface. These gave every appearance of having been formed by an expansion of the facing sand and an ultimate slipping or shearing at the surface. Fig. 1 indicates an exag-

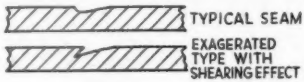

FIG. 1.—SECTIONS THROUGH SEAM DEFECTS IN CASTINGS.

gerated general appearance of the defect, and the shearing effect noted with the sharp sand mixture. Both are sectional diagrams.

These defects obviously occur very early in the pouring or freezing stage, or more probably still actually when pouring. This is indicated by the fact that the ruts appear to be delineated by the sides of the path taken by the ingoing metal, as in Fig. 2. The most

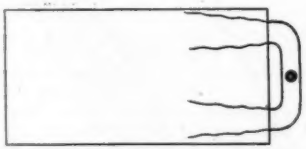

FIG. 2. — POSITION OF "RUT" DEFECTS IN RELATION TO THE INGATES.

probable explanation, therefore, is that the ingoing metal is directed by the structure of the ingate to pass over a limited area of facing sand before spreading over the whole mould face. This overheats the area to such an extent that its volume increase cannot be accommodated (for example, by a shrinkage of the bonding clay), and a pressure is therefore exerted on the adjacent facing sand which is at a lower temperature. This pressure results in a slight pushing inwards of the sand alongside the superheated area and forms the seam. In the condition described, where sharp sand was used, the expansion and sideways pressure was severe enough to cause an actual shearing as shown. The results obtained from these trials suggested that the volume of metal passing through an ingate had an effect upon the occurrence of these defects. Whilst this was partially borne out at a later stage by alterations of the ingates, the results were not conclusive and more positive improvement was obtained by maintaining the physical properties in the facing sand as already described, *i.e.*, by keeping the sand permeable or open, and by using the optimum amount of coal dust. The crushing effect on sand of a pan mill is not helpful and the desired permeability can be maintained by thorough *mixing* in preference to *milling*. Furthermore, a judicious increase in the number of ingates will always help in the avoidance of this defect.

Downgates and Ingates

A large number of otherwise good castings can be blemished by the inclusion of foreign material of an oxidised or slaggy nature, located, in the majority of cases, near the ingate or runner. Fortunately, most of these particles, by reason of their lower specific gravity, rise to the top of the mould and are therefore to be found on the back of the casting. Many are often trapped in the drag or bottom part of the mould, however, and are found on the face of the casting, presenting an almost impossible task to the enameller. The reason for their location near the runner is not difficult to visualise. Being lighter than the metal, the inclusions are carried along in front of the metal as it fills the mould area, and will likewise be carried to the last area to be filled, *i.e.*, that adjacent to the runner.

A great deal can be done to avoid these defects by attention to the points already mentioned, *i.e.*, proper slagging methods and slag condition, clean ladles and the use of skimmers. The type, size and disposition of the ingates also have their effect and probably no other factor has brought so many designs into practice. Fig. 3 illustrates a few of the simpler types.

So varied are the modifications that detailed examination is impossible in the space available. If, however, the object or theoretical function of the ingate is fully considered when making the working pattern, benefit will accrue. This function is twofold. The mould must be filled at a speed sufficient to avoid mis-runs, and impurities should be trapped before entering the mould. If the speed of the pouring through an ingate is too fast, it will be difficult to avoid the sucking-in of impurities, and if too slow, mis-runs will follow. It is preferable, therefore, to design the ingate so that the inlet on the casting edge is on the small side, *i.e.*, with relatively low cross-sectional area, and to increase the number of these inlets, and downgates if necessary, to attain the final casting speed required.

The choice of downgates is confined either to the tapered type, as favoured in floor moulding, or the pin type used in machine moulding. The almost parallel pin-gate fixed to the pattern is the safer and undoubtedly the cleaner, as the tapered type of downgate is worked loose and generally gives a broken mould at the junction with the ingate, as shown in Fig. 4. Either method is preferable to the cutting or tubing of downgates, a practice which is quite common and yet full of hazard. A hollow steel tube driven through the rammed top part to meet the ingate leaves a ragged downgate face and a badly-broken junction, and will certainly promote the very condition it is desired to avoid. Sand particles will be broken away by the inflow of metal and carried into the mould, causing the defect already described. Cleanliness of working is, therefore, even more important than design of runner.

Patterns and Their Care

A casting will only reflect the pattern, and this is equally true when aiming for the fine smooth surface which is a desirable feature of all castings for enamel-

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ling. Castings from a finely-machined pattern illustrate this point and emphasise the necessity for finishing of cast pattern plates in the best possible manner. As the conditions in a foundry are severe, this high finish must be maintained by care and attention, and rusting and scaling avoided by constant brushing and cleaning. An occasional clean with paraffin and a polish with beeswax is an old and effective method of maintaining a pattern in good condition—as, indeed, is any treatment which maintains finish and prevents deterioration. The storage of metal patterns under proper conditions is an obvious safeguard and sudden temperature drops and condensation of moisture on patterns should be avoided by heating and air-conditioning the store-room, no matter how simple the system.

Design for Enamelling

It has become increasingly obvious that for satisfactory production of castings for vitreous enamelling, a complete co-ordination between drawing office, patternshop, foundry and enamelling department is essential, and every detail of production must be carefully studied before the patterns are put into commission. The translation of a design to a casting is no rule-of-thumb job to be undertaken with a casual reference to current metal contraction in the foundry. It must be considered, if not yet as a science, then at least as a careful application of details learned by previous experience. Just as a pattern-maker must always remember the first rule of his craft—that a pattern must be made to mould—so must the designer recognise that a casting must be designed to enamel.

A slavish pursuit of weight reduction can be as misguided as the increasing of sections in a desire for rigidity and strength, and unless the designer is conversant with elementary metallurgy, or at least with that part relating to the mechanics of cooling, he will, at some time or other, run into a spell of trouble in

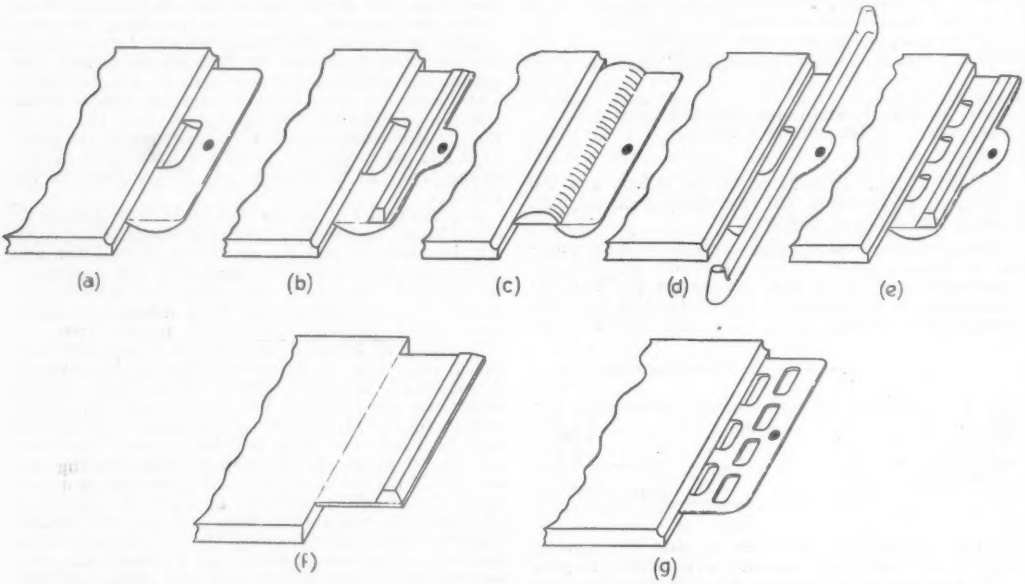

FIG. 3.—SIMPLE RUNNER DESIGNS FOR USE ON PLATE-TYPE CASTINGS. [(*a*), (*b*), (*c*), (*d*) AND (*e*) ARE RUNNERS PLACED IN THE DRAG HALF, (*f*) IS A "YANKEE" RUNNER, AND (*g*) A CORE-TRAP RUNNER IN THE COPE.]

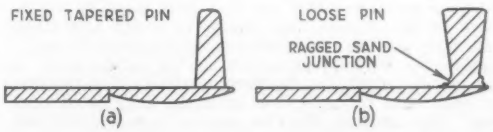

FIG. 4.—DOWNGATES, SHOWING THE DISADVANTAGE OF USING THE LOOSE-PIN TYPE.

the foundry or the enamelling department, or both, whether it take the form of cracking or "boiling" or one of the other common causes of failures.

Rate of Cooling

It is clear that the rate of cooling of a casting is a function of its surface area and its weight. In the case of a simple casting, Fig. 5(*a*), regular freezing will

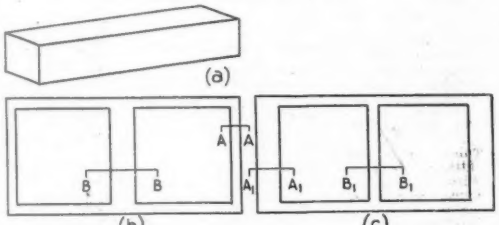

FIG. 5.—DESIGN AND RATE OF COOLING. (*a*) SIMPLE CASTING; (*b*) FRAME CASTING, HAVING HEAVY SECTION B–B AND LIGHT SECTION A–A, AND (*c*) FRAME WITH HEAVY SECTION A_1–A_1 AND LIGHT SECTION B_1–B_1.

take place inwards from all faces. The faces which have solidified first will be subjected to a final stress inwards by the eventual solidification and contraction of the core or centre part of the section.

If a bar be placed inside a frame casting, as in Fig. 5(*b*), where the bar section is greater than the frame section, then cooling strains will be set up which may result in casting cracks or buckling in section A-A. This is due to the initial freezing and

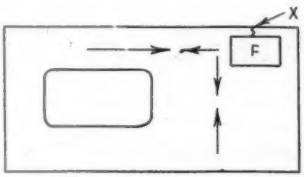

FIG. 6.—HOT-PLATE CASTING OF POOR DESIGN, FRACTURED AT X DURING ENAMELLING.

contraction of the thin frame at A-A which compresses the bar B-B while this is still in the plastic state; if the compressive stress is strong enough, a shortening of this bar will occur. When the bar itself solidifies, it will undergo solid contraction and exert a compression stress on the frame with the possible buckling or cracking of the latter.

If, on the other hand, a section within the frame be lighter than the frame itself, as in Fig. 5(*c*), the bar will solidify first and exert a compression on the frame, at A_1-A_1, whilst this is still plastic. A shortening effect will occur on solidification as before, but in the outer frame and subsequent solid contraction of A_1-A_1 will compress the inner member with a resultant buckle. The above examples are only intended as theoretical examples of cooling stresses; it is not suggested that such are to be found in everyday practice.

Cases have been noted, as in Fig. 6, where illogical design has given rise to considerable cracking and loss. In the case of this hotplate, a crack occurred during enamelling in the area X, leaving a gap which indicated tension in the light section. F was a flue opening, moulded very close to the back edge of the casting and the presence of which accelerated the freezing of the narrow strip at X, where the crack occurred. Had the hot-plate been a plain solid, it would have cooled in the same way as the casting illustrated in Fig. 5(*a*), *i.e.*, with the edges freezing first, the centre area finally contracting and exerting an inwards stress on the edges. The insertion of the flue opening, however, disturbed this regular cooling and set up opposing tensions, indicated by the arrows, resulting in the narrow strip of metal behind F. being subjected to tension and cracking. Increasing the cross-sectional area of this strip improved the position, but the case illustrates the sudden danger which can arise by the introduction of an innocent-looking opening in a straightforward casting.

Fig. 7 illustrates another case which is noteworthy,

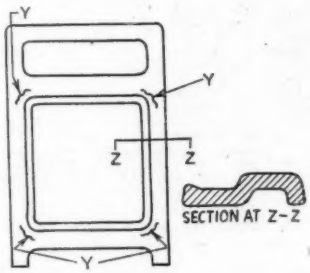

FIG. 7.—COOKER FRONT FRAME CASTING, WHICH FRACTURED AT POINTS Y, DURING ENAMELLING.

but here the casting was a cooker front frame and the cracks were internal, as shown at Y, *i.e.*, they did not extend to the edges. The design was otherwise excellent for enamelling, but the section was uniformly light. What, obviously, occurred in the corner sections, was the result of a freezing mechanism similar to that in a simple flat plate, where the edges are placed under stress inwards and the centre under tension. The centre, in this case, had insufficient cross-

(*Continued on page* 442)

Pig-iron and Steel Production in Great Britain

Summary of July Statistics

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for August, 1949, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in July, with the number of furnaces in blast; Table II, production of steel ingots and castings in July, and Table III, deliveries of finished steel. Table IV summarises steel-industry activities during the six months ended July, 1949.

TABLE I.—*Weekly Average Production of Pig-iron and Ferro-alloy during July, 1949. (Thousands of Tons.)*

District.	Furnaces in blast, 30.7.49	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	25	—	14.5	24.3	1.3	—	40.1
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	6	—	5.3	—	—	1.6	6.9
Lincolnshire	15	—	23.2	0.9	—	—	24.1
North-East Coast	23	7.5	33.1	0.8	—	1.4	42.8
Scotland	9	0.8	11.2	3.0	—	—	15.0
Staffs, Shrops., Worcs., and Warwick	9	—	8.9	1.5	—	—	10.4
S. Wales and Monmouthshire	8	4.0	19.0	—	—	—	23.0
North-West Coast	6	14.1	—	—	—	1.0	15.1
Total	101	26.4	115.2	30.5	1.3	4.0	177.4
June, 1949*	102	28.0	122.4	30.9	1.5	3.0	185.8
July, 1948	101	26.4	113.5	26.2	1.8	3.4	171.3

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel. (Thousands of Tons.)*

Product.	1947 (53 weeks).	1948.	1948. July.	1949. June.*	1949. July.
Non-alloy Steel:—					
Heavy rails and sleepers	7.6	8.9	7.1	10.1	8.5
Heavy and medium plates	31.6	36.2	26.5	41.7	26.3
Other heavy products	31.8	34.7	27.9	37.3	30.8
Light rolled products§	52.9	59.5	49.9	45.4	40.9
Hot-rolled strip				17.2	16.4
Cold-rolled strip	4.6	4.7	4.2	4.7	4.1
Bright steel bars	4.8	6.0	5.4	5.5	4.8
Sheets, coated and uncoated	24.3	26.3	25.5	26.9	23.6
Tin, terne and blackplate	12.1	13.5	14.0	12.9	12.0
Tubes, pipes and fittings	13.5	15.1	14.3	17.9	15.8
Wire	10.8	12.8	10.6	15.2	12.3
Tyres, wheels and axles	3.5	3.9	3.4	4.1	4.1
Forgings	5.0	6.0	4.5	6.4	5.3
Castings	3.0	3.5	3.1	3.4	3.4
Total	205.5	231.1	196.4	248.7	208.3
Alloy Steel†:—					
Tubes and pipes	0.3	0.4	0.3	0.5	0.3
Bars, sheets, strip and wire	3.7	4.7	3.9	4.4	3.7
Forgings	1.8	2.5	1.9	2.6	2.2
Castings	0.6	0.7	0.5	0.6	0.6
Total	6.4	8.3	6.6	8.1	6.8
Total U.K. production‡	211.9	239.4	203.0	256.8	215.1
Less intra-industry conversion	10.2	29.0	21.8	35.0	28.6
Net U.K. deliveries	192.7	210.4	181.2	221.8	186.5
Add imported finished steel	2.2	3.4	2.9	13.7	11.5
Total deliveries of finished steel	194.9	213.8	184.1	235.5	198.0

† Excludes high-speed steel. ‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
§ Excl. wire rods and alloy-steel bars, but incl. ferro-concrete bars.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings, July, 1949. (Thousands of Tons.)*

District.	Open hearth. Acid.	Open hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex	—	—	10.8(Basic)	1.5	0.2	12.0	0.5	12.5
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (excl. N.E. Coast and Sheffield)	1.3	17.3	—	1.1	0.4	19.3	0.8	20.1
Lincolnshire	—	16.2	—	—	0.1	16.2	0.1	16.3
North-East Coast	1.9	50.6	—	0.5	0.4	52.2	1.2	53.4
Scotland	2.6	23.5	—	1.0	0.5	26.5	1.1	27.6
Staffs., Shrops., Worcs. and Warwick	—	10.4	—	0.5	0.5	10.5	0.9	11.4
S. Wales and Monmouthshire	9.2	45.4	5.6(Basic)	0.7	0.1	60.7	0.3	61.0
Sheffield (incl. small quantity in Manchester)	6.9	22.0	—	6.0	0.5	33.9	1.5	35.4
North-West Coast	0.6	2.4	3.2 (Acid)	0.2	0.1	6.4	0.1	6.5
Total	22.5	187.8	19.6	11.5	2.8	237.7	6.5	244.2
June, 1949*	25.5	237.0	21.0	14.3	3.1	293.0	7.9	300.9
July, 1948	21.4	178.1	18.9	11.2	2.8	226.2	6.2	232.4

*Five weeks.

(*Continued at foot of following page.*)

Increases of Capital

Details of increased capital have been announced by the following companies:—

ALLIED IRONFOUNDERS, LIMITED, London, W.1, increased by £900,000, in £1 ordinary shares, beyond the registered capital of £3,600,000.

HILL TOP FOUNDRY COMPANY, LIMITED, Wednesbury, Staffs, increased by £30,000, in 1s. ordinary shares, beyond the registered capital of £60,000.

ELECTROFLO METERS COMPANY, LIMITED, Park Royal, London, N.W.10, increased by £50,000, in 10s. shares, beyond the registered capital of £21,000.

LEE, HOWL & COMPANY, LIMITED, engineers, founders, etc., of Tipton, Staffs, increased by £25,000, in £1 ordinary shares, beyond the registered capital of £75,000.

ARTHUR LEE & SONS (HOT ROLLING MILLS), LIMITED, Sheffield, 9, increased by £75,000, in £1 ordinary shares, beyond the registered capital of £60,000.

EDWARD KEMPSTER & SONS, LIMITED, engineers, founders, etc., of Bury, increased by £10,000, in £1 shares, beyond the registered capital of £10,000.

BROADHEATH ALUMINIUM BRONZE COMPANY, LIMITED, Broadheath, Ches, increased by £4,500, in £1 shares, beyond the registered capital of £500.

CLAPHAM BROS., LIMITED, foundries, iron merchants, etc., of Keighley, increased by £20,000, in 4,000 ordinary shares of £5, beyond the registered capital of £80.000.

INTERNATIONAL COMBUSTION, LIMITED, London, W.C.1, increased by £998,302, in 3,993,208 ordinary shares of 5s. each, beyond the registered capital of £501,698.

THOMAS HOLT, LIMITED, engineers, toolmakers, etc., of Rochdale, increased by £36,500, in 1,300 ordinary shares of £5 each, beyond the registered capital of £70,000.

JOHN THOMPSON, LIMITED, boiler manufacturers, etc., of Ettingshall, Wolverhampton, increased by £150,000, in 5s. ordinary shares, beyond the registered capital of £1,100,000.

MIDLAND ELECTRIC MANUFACTURING COMPANY, LIMITED, Tyseley, Birmingham, 11, increased by £300,000, in £1 ordinary shares, beyond the registered capital of £225,000.

JOHN LUND, LIMITED, machine-tool makers, ironfounders, etc., of Cross Hills, near Keighley, increased by £25,000, in £1 ordinary shares, beyond the registered capital of £75,000.

MITCHELL, RUSSELL & COMPANY, LIMITED, range manufacturers, etc., of Bonnybridge, increased by £50,000, in £1 ordinary shares, beyond the registered capital of £100,000.

BRADMORE MANUFACTURING COMPANY, LIMITED, founders, metallurgists, etc., of London, N.W.3, increased by £400, in £1 ordinary shares, beyond the registered capital of £100.

YORKSHIRE COPPER WORKS, LIMITED, Stourton, near Leeds, increased by £780,883, in 417,448 second preference and 363,435 ordinary shares of £1, beyond the registered capital of £600,000.

FOLLSAIN-WYCLIFFE FOUNDRIES, LIMITED, Lutterworth, near Rugby, increased by £17 13s. 1d., in 4,117 ordinary shares of 1d. each, beyond the registered capital of £94,032 16s. 11d.

JOHNSON FOUNDRIES, LIMITED, Stockport, increased by £10,000, in 800 redeemable 1st preference and 200 redeemable 2nd participating preference shares of £10 each, beyond the registered capital of £15,000.

R. A. LISTER & COMPANY, LIMITED, founders, engineers, machinery manufacturers, etc., of Dursley, Glos, increased by £2,000,000, in £1 ordinary shares, beyond the registered capital of £1,600,000.

HEELEY & PEART, LIMITED, malleable-iron founders, etc., of Birmingham, increased by £14,000, in £1 shares, beyond the registered capital of £36,000.
beyond the registered capital £100.

QUALTER, HALL & COMPANY, LIMITED, engineers and ironfounders, etc., of Barnsley, increased by £100,000, in £1 6 per cent. non-cumulative redeemable preference shares, beyond the registered capital of £15,000.

H. W. DENNIS & COMPANY, LIMITED, iron, steel, and brass founders, etc., of Nottingham, increased by £15,000 in 12,000 ordinary and 3,000 10 per cent. redeemable preference shares of £1, beyond the registered capital of £10,000.

REED BROS. (ENGINEERING), LIMITED, manufacturers of machinery, plant, etc., of Millwal', London, E.14, increased by £10,000, in 2,500 non-cumulative preference and 7,500 preferred ordinary shares of £1, beyond the registered capital of £5,000.

Gazette

THE COMPANIES' REGISTRATION OFFICE gives notice that the undermentioned companies have been struck off the register and are thereby dissolved:—CAXTON METAL COMPANY, LIMITED; EPISCOPIC GAUGE COMPANY, LIMITED; SELSON GRINDING COMPANY, LIMITED; AUTOMATIC & GENERAL ENGINEERING COMPANY, LIMITED; DIESEL COMPRESSOR PLANT COMPANY, LIMITED; BIRMINGHAM COAL COMPANY, LIMITED; CURZON MACHINE COMPANY, LIMITED; HUNTER ENGINEERING (SYNDICATE) COMPANY, LIMITED; SELF-LUBRICATING (CAPILLARY) BEARINGS, LIMITED; BILSTON SPRINGS, LIMITED; CETAS ENGINEERING COMPANY, LIMITED; CORNBROOK COAL COMPANY, LIMITED; S.C.B. ENGINEERING SYNDICATE, LIMITED; CIVIL ENGINEERS PLANT, LIMITED; DUNHOLME COLLIERIES, LIMITED; EAST FINCHLEY COAL COMPANY, LIMITED; H. E. & M. ENGINEERING COMPANY, LIMITED; BELFIT HILL COLLIERY COMPANY, LIMITED; COLLAPSIBLE BOX MACHINERY COMPANY, LIMITED; COVENTRY GEARLESS MOTORS, LIMITED; INTERNATIONAL ALL STEEL AIRCRAFT SYNDICATE, LIMITED; STANDARD PEAT & COAL COMPANY (BRISTOL), LIMITED; VAL D'OR TOOL COMPANY, LIMITED.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page*).

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			
						Imports.‡	Output of ingots and castings.	Deliveries of finished steel.	Stocks.†
1938	228	89	—	130	118	16	200	—	—
1947 (53 weeks)	209	136	165	147	145	8	240	195	797
1948	252	172	200	178	174	8	286	214	1,028
1949—February	267	160	201	181	198	13	311	236	1,000
March*	263	158	198	179	199	20	313	242	1,031
April	255	163	198	179	192	20	305	226	1,097
May	263	171	201	187	199	22	316	245	1,121
June*	268	168	202	186	188	28	301	236	1,177§
July	258	164	194	177	152	21	244	198	1,238

* Five weeks. † Stocks at end of years and months shown. ‡ Weekly average of calendar month. § Revised.

Light Castings for Vitreous Enamelling

(*Continued from page* 439)

sectional area to withstand the tension and cracked in the manner shown. The obvious remedy was a thickening of the section in the corner areas, and this did in fact prove satisfactory.

Warping

In the case of warping of flat castings, it is most difficult to predict the effect of the cooling stresses. The pattern-maker may apply camber on the assumption that compression cooling stresses along the edge will remove this and leave the edge straight. Openings, cut-outs, ribs and flanges which may be necessary in the design, are likely to alter the cooling stresses materially and give an altogether different result from that anticipated. Our forerunners in the foundry had an effective remedy for such troubles, generally in the shape of a strengthening piece of rib on the back edge of the offending member. This is not always possible, however, and it is preferable to design a flat section with the possibility of edge stresses in mind, and to gradually increase the section or thickness towards the edge. Fig. 8 illustrates these points.

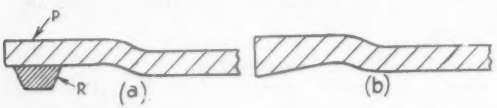

FIG. 8.—METHODS OF EDGE DESIGN TO PREVENT WARPING. (*a*) USING RIB, R, AS A STRENGTHENER, PINHOLING LIKELY TO ARISE AT P; (*b*) SECTIONAL INCREASE TOWARDS THE EDGE.

"Boiling" during Enamelling

Probably among the most irritating features of casting design to an enameller is the appearance of bosses and lugs on the back of castings of light sections. These invariably result in blistering or "boiling" of the enamel on the face unless safety is sought in the expedient of grip coats. If the boss be chilled in any manner whatever, *e.g.*, by casting-in a screw or by the use of a separate chill, the "boil" will be greatly reduced, and may in some cases be eliminated. This suggests that the "boiling" is due to gas evolution from the more graphitic structure of the heavy section. In the examination of dissolved gases in alloys, several investigators have found that those alloys with the maximum degree of soundness, contain the largest amount of dissolved gases, and *vice versa*. The reason for this is still obscure, but it explains the defect of "boiling" on heavy sections when enamelling. These sections are less sound than the surrounding area of metal, and less able to retain dissolved gas. Therefore, during cooling after enamelling, the heavy section expels the dissolved gases with consequent blistering of the covering layer of enamel. Conversely, the surrounding area of thinner section and sounder structure is able to retain more dissolved gas or expels insufficient gas to have any effect on the enamel layer.

The more up-to-date method of dealing with bosses and heavy sections which are essential to the design, is to make them cored or hollow on the reverse side and thereby achieve the soundness of structure or chilling effect which is essential.

Summary

An attempt has been made in the foregoing remarks to deal with some of the essentials in light-casting production for vitreous enamelling, but the limited time and the number of factors involved make it essentially an outline account only, and any one of the factors is in itself worthy of concentrated attention. If, however, the remarks serve to stimulate discussion they will have achieved their intended purpose.

New Australian Tinplate Works

Broken Hill Project

Some details of the great tinplate works which Broken Hill Proprietary, Limited, will erect at Port Kembla, 60 miles to the south of Sydney, have just been released. The new plant will form an integral part of a steelworks which is operated by a subsidiary of the company, and will contain a hot and cold strip mill and a tinplate section. More than 29 acres will be under roof and one building will be almost 700 yards long. The hot strip mill will consist of four breakdown stands and six continuous finishing stands. The final breakdown will be an 86-in. reversing roughing mill. It will be capable not only of rolling feed for the finishing mill, but also of rolling plates up to certain widths. The hot finishing mill will consist of six stands each of 66 in. in width. It will be capable of rolling coiled strip from 19 in. to 60 in. wide, and in thicknesses down to 18 gauge. This coiled strip will serve as feed for the cold rolling and tinplate plant. It will also be suitable for rolling into other sheet products.

For the manufacture of tinplate, the hot-rolled strip, up to 36 in. wide, will pass first to the continuous pickling line, thence to the cold rolling mill. The cold mill is a five-stand unit 42 in. wide with a top delivery speed of 3,850 ft. per min. This mill will be followed by electrolytic cleaners, annealing hoods, and a four-high temper mill. The temper mill will have a maximum delivery speed of 3,300 ft. a minute.

A TECHNICAL COLLEGE for the vocational education of young engineers has been opened by the Education Department of Glasgow Corporation in Broad Street, with accommodation for 1,500 part-time day students and 700 evening students. The premises include six workshops, four laboratories, and two drawing offices. The principal will be Mr. E. Otty, who is at present teacher in charge of engineering subjects at the Technical College, Burton-on-Trent.

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Raw Material Markets

Iron and Steel

Available supplies of foundry pig-iron and hematite are generally sufficient for immediate consumption. High-phosphorus iron for the light foundries is in fairly good supply; stocks at both the furnaces and the foundries are not heavy, but sufficient supplies can usually be secured for immediate purposes. The improved supply position can be judged by the fact that the light foundries are now more discriminating in their specifications and will accept only those grades and qualities most suitable for their needs. For this reason many furnaces have difficulty in finding a market for No. 4 foundry iron or the low-silicon grades.

The engineering, speciality, and jobbing foundries are absorbing all available tonnages of the low- and medium-phosphorus grades and reserves are at a minimum. A good demand persists for hematite and many foundries could take up larger quantities, particularly in the higher-silicon grade. At present they have to be content with the lower silicon irons and the use of ferro-silicon in their mixtures. Supplies of the refined grade continue to be easy and users are able to obtain the desired quantities and analyses. Scrap is in better supply, but demand is brisk for heavy cast-iron and steel scrap for cupola use.

Foundry coke supplies are plentiful and provide for both current consumption and stock according to scheduled quantities. The quality and size, generally, appear to have shown improvement recently. Furnace coke for heating and core-oven use is in good supply, while there is no difficulty in obtaining the required quantities of ganister, limestone, and ferro-alloys. Firebricks can be procured fairly easily, providing sufficient notice is given for delivery.

It would appear that the home demand for re-rolled products is considerably less insistent than it was in the first half of the year and competition in foreign markets is increasing. Hence there is a lessened demand for steel semis, which during the summer months have been imported in substantial tonnages from France and Belgium. Some curtailment of foreign purchases seems to be indicated, although substantial tonnages of bars are still required for the sheet mills. Good supplies of home-produced billets, blooms, and slabs are now available and the re-rollers' chief concern is to secure additional orders for Period IV.

Plate mills report a steady flow of specifications and full absorption of maximum outputs is assured until the end of the year. A similar position exists at the rail, sheet, and wire mills, but orders for large sections are not flowing so freely, and if the Government's measures to meet the crisis embrace any curtailment of capital expenditure, rollers of sectional material may soon be seeking orders. Colliery specifications for the next three months are again on an impressive scale and tubemakers' commitments extend over long forward periods.

Non-ferrous Metals

A fall of ¼ cent in the American lead price to 14¼ cents per lb. was followed by a reduction of £3 in the United Kingdom quotation, from £122 to £119 per ton. Since then, however, there has been a further drop of ¼ cent in the U.S. quotation, and on Monday the Ministry of Supply announced that its selling price had again been reduced, this time by £4 per ton.

Scrap has appreciated since the pound was devalued, and in the first week of the devaluation holders entertained ambitious ideas about values, but with buyers rather half-hearted in their response, there has been some scaling down of quotations and an inclination on the part of the seller to take a more reasonable view. Negotiations between the London Metal Exchange Committee and the Ministry of Supply regarding the reopening of the tin market are reported to be proceeding satisfactorily, and it has been suggested that operations in warrants might begin at the end of the present month. In the meantime, business is very slow, for traders do not believe that the price can be maintained at £750 per ton. Whether or not the smelters are selling to the Government on the basis of the old price, which, it has been reported, is the only offer they have received from the authorities, is not clear, but it must be presumed that they are not. It is difficult to judge the situation in America, but it would not appear that there is much activity in the tin market there. There is no evidence that the American consumer is particularly attracted by a price of 95 cents per lb.

Figures published by the British Bureau of Non-ferrous Metal Statistics show that August was a better month for copper consumption than July, when the total usage in the U.K. was 34,629 tons. August saw an increase of nearly 3,500 tons to 38,075 tons, of which 24,913 tons were virgin and 13,162 tons secondary. The corresponding figures in July were 22,667 tons, virgin, and 11,962 tons, secondary. For the first eight months of this year U.K. consumption of copper totalled 328,586 tons, compared with 363,303 tons in the same period of 1948. Stocks are still rising and have reached a figure of 149,948 tons at August 31, or nearly 8,000 tons up on the July total of 142,084 tons. Of the August tonnage, all but about 20,000 tons belonged to the Government.

The improvement in activity during August was somewhat unexpected, for it is, after all, the biggest holiday month of the year. Now that dollar metal is even further out of our reach than formerly, much interest attaches to Rhodesian supplies which are running at fully 20,000 tons per month.

SIR HARRY SMITH, managing director of Dean, Smith & Grace, Limited, lathe manufacturers and iron-founders, of Keighley, Yorks, died on Monday at the age of 71. He had been connected with the firm for 58 years. His father was one of the founders of the firm in 1865.

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Personal

DR. PAUL BASTIEN, the well-known French metallurgist, has been nominated a Chevalier de la Lègion d'Honneur.

MR. JOHN SCOTT, secretary of the Millom & Askam Hematite Iron Company, Limited, has been appointed a magistrate for Cumberland.

PROF. H. E. M. BARLOW has been appointed Dean of the Faculty of Engineering at University College, London, in succession to Prof. H. J. Collins.

MR. T. S. SMITH, a director of A. S. Smith & Sons, Limited, malleable-iron and brass founders, of Walsall, has been elected a member of Walsall Town Council.

MR. C. R. TOTTLE, a prominent member of the Newcastle Branch of the Institute of British Foundrymen, has been awarded the degree of M.Met. of Sheffield University.

MR. A. J. MURPHY, M.Sc., a past-president of the London Branch of the Institute of British Foundrymen, has been appointed Professor of Industrial Metallurgy at Birmingham University.

MR. T. E. PARKINSON has resigned his position as secretary of the Council of Ironfoundry Associations on being appointed manager at one of the largest machine-tool concerns in the country.

MR. L. H. HALLING, of High Duty Alloys, Limited, has been appointed sales area manager for Scotland, Northern Ireland and the three counties of Cumberland, Durham and Northumberland.

MR. I. A. R. STEDEFORD, chairman of Tube Investments, Limited, has been appointed to the committee of inquiry into British broadcasting services following the resignation of Sir William Coates.

SIR ARTHUR SMOUT, president of the Institute of Metals and a director of Imperial Chemical Industries, Limited, has been elected an honorary member of the Metallurgical and Mining Society of South Africa.

MR. E. M. SUMMERS, blast-furnace manager of the Holwell Works (Melton Mowbray) of the Stanton Ironworks Company, Limited, has been appointed general superintendent of the works in addition to his present post. He is 36.

MR. H. J. YOUNG, F.I.M., M.I.Mech.E., following his resignation as foundry manager to Mather & Platt, Limited, Manchester, was presented with a travelling bag and umbrella by the employees of his Department. Mr. Young is to act as consultant for Mather & Platt and other companies.

Wills

FERGUSON, CHARLES, of Robertson & Ferguson, Limited, welding specialists and drop forgers, of Edinburgh	£7,454
INGRAM, W. S., for many years a director of Walter W. Coltman & Company, Limited, boilermakers, of Loughborough	£2,918
HIPKINS, B. E., late director of John Fraser & Son, Limited, manufacturing engineers and boilermakers, of Millwall, London, E.14	£3,308
BARNES, WILLIAM, chairman of the Premier Electric Welding Company (Mersey), Limited, and managing director of Charles Howson & Company, Limited, shiprepairers and engineers, of Liverpool	£54,177

News in Brief

THE NON-FERROUS METALS GROUP was the only one of the principal export items of British industry which during August succeeded in passing the monthly target set for achievement by the end of the year.

LOWE & BROOKES, LIMITED, malleable-iron founders, etc., of Blackheath, Staffs, recently celebrated its golden jubilee. Mr. H. Lowe, now a director, was one of the original workers of the company.

THE MINISTER OF FOOD announces that no change will be made in the prices of unrefined oils and fats and technical animal fats allocated to primary wholesalers and large trade users during the five-week period ending November 5, 1949.

ALFRED GRINDROD & COMPANY, LIMITED, heating and ventilating engineers, etc., of Sheffield, recently celebrated its jubilee. The business was founded in 1899 with 12 employees, and the present managing director, Mr. Stephen Grindrod, is the son of the founder.

"IRON AGE" reports that an anvil casting, weighing about 20 tons with its feeding head, has been made in nodular iron. The piece will finish at about 17 tons and is the largest yet produced in the new magnesium-treated cast iron. Heretofore the part has been cast in steel.

THE TYNE IMPROVEMENT COMMISSION has accepted the tender of Priestman Bros., Limited, Hull, at £1,652, for the supply of four cactus grabs for discharging vessels at Tyne Dock. The tender of Sharman, Limited, Sunbury-on-Thames, at £2,884, for extending the fitting shop at the engineers' yard at the Albert Edward Dock, North Shields, has also been accepted.

FOLLOWING THE initial success of the first all-carbon blast furnace in the world which was put into operation last April at the North Ironworks of the Appleby-Frodingham branch of the United Steel Companies, Limited, the company is now relining another furnace at the works with carbon bricks. It is claimed that the use of these bricks for the refractory lining of furnaces enables them to work more smoothly, yield greater and more regular outputs, and generally makes them easier to handle.

Death of Mr. C. H. Harper

MR. CHARLES HOLLAND HARPER, who died on September 27, joined the family business of John Harper & Company, Limited, general ironfounders, etc., of Willenhall, Staffs, at an early age, retiring in 1945 from the board and the chairmanship of the company. Mr. Harper, who was 83, was a former honorary treasurer of Birmingham Chamber of Commerce and chairman of the British Industries Fair Management Committee. He was the father of Mr. Wilfrid H. Harper, the present managing director of John Harper & Company, Limited.

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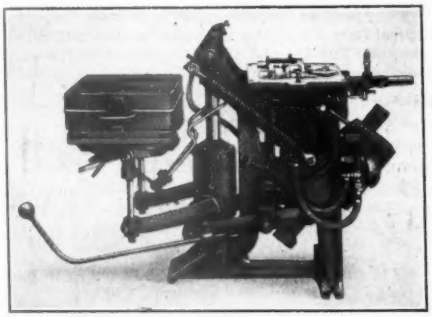

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Foundry News
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We are always pleased to send particulars or discuss the economical application of New Process Pig Iron for any given type of casting. Our Research Department has invaluable data on such factors as wear, heat and corrosion resistance.
Send for our booklet No. 142 which tells you how to select the best iron for your particular job
ARMSTRONG WHITWORTH

SIR W. G. ARMSTRONG WHITWORTH & CO. (IRONFOUNDERS) LTD.

CLOSE WORKS, GATESHEAD-ON-TYNE.

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered, unless otherwise stated*)

October 5, 1949

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough. £10 4s.; Birmingham, £10 0s. 6d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £11 15s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si)—North Zone, £12 2s. 6d.; South Zone, £12 5s.

Scotch Iron.—No. 3 foundry, £11 18s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £12 14s. 6d.; South Zone, £12 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £13 4s. 6d.; South Zone, £13 7s.

Cold Blast.—South Staffs, £15 16s. 6d.

Hematite.—Si up to 2½ per cent., S & P over 0.03 to 0.05 per cent.; N.-E. Coast and N.-W. Coast of England, £11 16s. 6d.; Scotland, £12 3s.; Sheffield, £12 9s.; Birmingham, £12 15s.; Wales (Welsh iron), £11 16s. 6d.

Spiegeleisen.—20 per cent. Mn, £17 8s.

Basic Pig-iron.—£9 17s. 6d., all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.*)

Ferro-silicon (6-ton lots).—20/30 per cent., £25 15s.; 40/55 per cent., £32 10s.; 70/85 per cent., £49.

Ferro-vanadium.—35/50 per cent., 15s. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. 5d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 6s. 6d. lb.

Tungsten Metal Powder.—98/99 per cent., 7s. 6d. lb.

Ferro-chrome.—4/8 per cent. C, £60; max. 2 per cent. C, 1s. 5d. lb.; max. 1 per cent. C, 1s. 5½d. lb.; max. 0.15 per cent. C, 1s. 6½d. lb.

Cobalt.—98/99 per cent., 12s. lb.

Metallic Chromium.—96/98 per cent., 5s. 1d. lb.

Ferro-manganese (blast-furnace).—78 per cent., £25 3s.

Metallic Manganese.—94/96 per cent., carbon-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., £16 16s. 6d.; tested, up to 0.25 per cent. C (100-ton lots), £17 1s. 6d.; hard (0.42 to 0.60 per cent. C), £18 16s. 6d.; silico-manganese, £23 19s.; free-cutting, £20 1s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £22 4s.; case-hardening, £23 1s. 6d.; silico-manganese, £26 6s. 6d.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £19 16s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £21 1s. 6d.; acid, up to 0.25 per cent. C, £23 1s. 6d.

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Plates, ship (N.-E. Coast), £20 14s. 6d.; boiler plates (N.-E. Coast), £22 2s.; chequer plates (N.-E. Coast), £22 19s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £19 13s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £22 6s.; flats, 5 in. wide and under, £22 6s.; rails, heavy, f.o.t., £19 2s. 6d.; hoop and strip, £23 1s.; black sheets, 17/20 g., £28 16s.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £35 6s. 6d.; nickel-chrome, £49 18s. 6d.; nickel-chrome-molybdenum, £55 0s. 9d.

Tinplates.—I.C. cokes, 20 × 14, per box, 41s. 6d., f.o.t. makers' works.

NON-FERROUS METALS

Copper.—Electrolytic, £140; high-grade fire-refined, £139 10s.; fire-refined of not less than 99.7 per cent., £139; ditto, 99.2 per cent., £138 10s.; black hot-rolled wire rods, £146.

Tin.—99 to under 99.75 per cent., £750; 99.75 to under 99.9 per cent., £757; min. 99.9 per cent., £760.

Zinc.—G.O.B. (foreign) (duty paid), £87 10s.; ditto (domestic), £87 10s.; "Prime Western," £87 10s.; electrolytic, £88 5s.; not less than 99.99 per cent., £89 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £115; ditto (Empire and domestic), £115.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £103 10s.; rolled zinc (boiler plates), all English destinations, £101 10s.; zinc oxide (Red Seal), d/d buyers' premises, £84.

Other Metals.—Aluminium, ingots, £112; antimony, English, 99 per cent., £185; quicksilver, ex warehouse, £26 5s.; nickel, £321 10s.

Brass.—Solid-drawn tubes, 23⅛d. per lb.; rods, drawn, 19⅛; sheets to 10 w.g., 19d.; wire, 19⅝d.; rolled metal, 17¾d.

Copper Tubes, etc.—Solid-drawn tubes, 23¼d. per lb.; wire, 161s. per cwt. basis; 20 s.w.g., 183s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £108; BS. 1400—L.G.3—1 (86/7/5/2), £114 10s.; BS. 1400—G1—1 (88/10/2), £152—£203 per ton, delivered.

Phosphor-bronze Ingots (indications only).—P.Bl, £170; L.P.Bl, £114 per ton.

Phosphor Bronze.—Strip, 27d. per lb.; sheets to 10 w.g. 28¾d.; wire, 28¾d.; rods, 27¾d.; tubes, 32¼d.; chill cast bars: solids, 28¼d., cored, 29¼d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 1s. 8¾d. per lb. (7%) to 2s. 6¾d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 2s. 2¾d. (7%) to 3s. 0¾d. (30%); to 12 in. wide, × .056, 2s. 3d. to 3s. 1d.; to 25 in. wide, × .056, 2s. 5d. to 3s. 3d. Spoon and fork metal, unsheared, 2s. 1¼d. to 2s. 11¼d. Wire, 10g., in coils, 2s. 8d. (10%) to 3s. 6¼d. (30%). Special quality turning rod, 10%, 2s. 7d.; 15%, 2s. 11¼d.; 18%, 3s. 3¾d.

Notes from the Branches

Newcastle-upon-Tyne

The Newcastle-upon-Tyne Branch of the Institute of British Foundrymen held the opening meeting of the 1949-50 session on Saturday, September 10, in the Neville Hall.

The President, Mr. H. Smith, said that it was not without some trepidation that he entered upon his duties; he was, however, pleased to learn that considerable progress had been made with the formation of the Branch Library located in the Department of Metallurgy, King's College. This was evident from the advance list of the books of reference, magazines, etc., circulated to members. The thanks of the Branch were due to the Department and particularly to Mr. C. R. Tottle, M.Met., who was in charge of the Library. Mr. Smith asked members to assist in any way they could; donations of cash or technical books would be welcomed.

MR. TOTTLE, interposing, said they were not yet ready to issue books, but the Branch would be notified of the opening day.

Apprentice Situation

THE PRESIDENT, continuing, directed the attention of the meeting to the advisability of bringing in more members to strengthen the prestige of the Branch. He was much concerned, as were many others in the country, with the meagre intake of apprentices—it was negligible in the Newcastle district. It was causing alarm in the trade, but he scarcely considered it was apathy on the part of the management. Certaintly, in many foundries the conditions were not good, bad lighting and indifferent ventilation were perhaps the principal drawbacks. With these conditions it must be admitted that the foundry did not have much appeal to youths when there were more attractive openings in other trades.

He asked for a co-operative spirit to be developed. The lack of this might easily result in an unbalanced foundry, and being the cause of other sections of a factory being held up. It had to be remembered that home industries were in competition with other countries in the markets of the world. That foundries can be made more attractive was shown in the works of C. A. Parsons & Company, Limited, where the new foundry had excellent lighting and a perfect ventilating system. He voiced the feeling of the Branch in testifying their appreciation of the appointment at the Cheltenham Conference of Mr. Colin Gresty as junior vice-president of the Institute.

MR. GRESTY, acknowledging congratulations, said he regarded the office to which he had been raised as a compliment to the Newcastle Branch rather than to himself personally. He was led to hope that the 1951 conference would take place in Newcastle where visitors would be quite near to a number of large and interesting works.

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LIVERPOOL, 2. 13, Rumford St. Central 1558
GLASGOW, C.2. 98, Hope Street, Central 9969

Situations advertised under this heading are available only to applicants excepted from the Control of Engagement Order, 1947, No. 2021.

SITUATIONS WANTED

ADVERTISER, WORKS MANAGER, large light castings foundry, with wide general experience, first-class education and administratoive ability, seeks Partnership in small or medium size Iron Foundry, with view to early managership; capital available; replies strictly confidential.—Box 448, FOUNDRY TRADE JOURNAL.

EXPERIENCED Precision Casting Technician requires position as TECHNICAL ADVISER or TECHNICAL SALES REPRESENTATIVE with firm engaged in production of ferrous precision castings by last war process.—Box 458, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, with 10 years' practical experience in ferrous and non-ferrous metals; practical moulder in all latest mechanised methods; used to handling skilled and semi-skilled men in highest production to most exacting standards.—Box 452, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN seeks position as same; full qualifications; medium general grey iron or aluminium foundry; not afraid of work; could train unskilled hands; Midlands.—Box 428, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

AN Engineering Company in South-East Essex require a FOUNDRY SUPERINTENDENT; the post offers good prospects to a man who has sound practical experience in modern methods of machine, loose pattern, dry sand and loam moulding.—Replies, stating age, qualifications and salary required, to Box 456, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited for the position of ASSISTANT CHIEF METALLURGIST to a well known West of England Malleable and Grey Iron Foundry; the successful applicant will automatically be promoted to Chief Works Metallurgist in the course of the next two years; it is essential that applicants give full technical and practical qualifications, particularly in the manufacture of "Blackheart" Malleable Iron, also state salary required, age, and previous experience; all applications will be treated with the strictest confidence.—Box 454, FOUNDRY TRADE JOURNAL.

FOREMAN required by London Iron Foundry, to take full charge of production of medium and light jobbing work and machine moulding; about twenty moulders employed; must be familiar with piecework and bonus systems; strict disciplinarian required.—Replies, qualifications, salary required, in confidence, to Box 386, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

APPLICATIONS are invited for position of METALLURGIST for Non-ferrous Metal Ingot makers; qualifications to include sound practical experience and technical knowledge in the melting and treatment of scrap and residues; the position, which carries an excellent salary, is one of responsibility, with scope for initiative, giving opportunity of advancement on initial remuneration.—Apply, giving details of qualifications, age, etc., to Box 440, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited for the appointment of SALES MANAGER, in the Light Castings Department of Newton, Chambers & Co., Ltd.

The duties will involve responsibility for sales policy and organisation, control of representatives, and publicity.

Applicants must possess up-to-date knowledge of modern solid fuel-burning appliances.

Please apply, stating age, experience, education and salary, to NEWTON, CHAMBERS & CO., LTD., Thorncliffe, near Sheffield.

CORE SHOP FOREMAN for Light Alloy Foundry in Midlands; experienced in Motor, Aero and General Engineering work.—Apply, stating age, experience and salary.—Box 390, FOUNDRY TRADE JOURNAL.

WANTED
Works Manager/Chief Engineer

ENGINEER required, to take over responsibilities of Works Manager and Chief Engineer of modern medium-sized Foundry in Midlands; must have had sound engineering training and accustomed to plant maintenance; also experienced in production procedure; expert knowledge of foundry technique not essential; good salary and prospects.—Apply Box 416, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required for North Midlands Foundry; experience in floor moulding and grey and alloy iron castings up to 3 tons weight essential.—Reply, stating age, details of experience, and salary required, Box 420, FOUNDRY TRADE JOURNAL.

SALESMAN required for large Heavy Duty Iron Founders in the Midlands area, to work in London and the Southern area; applicants must be capable of reading drawings, and obtaining orders for repetition castings.—Replies, giving full details of career to date, to Box 376, FOUNDRY TRADE JOURNAL.

WANTED.—For progressive Midland Blackheart Malleable Foundry, FOUNDRY FOREMAN: strict disciplinarian; knowledge of jobbing and machine moulding practice; good prospect with old established firm.—Write, with full details of education, experience of technical knowledge, and age, Box 450, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

FOUNDRY FOREMAN required; must have first-class practical experience in the production of high grade Non-ferrous Castings.—Apply, giving age, and full details of experience, to THE ANTI-ATTRITION METAL CO., LTD., Woodlands Park Works, Maidenhead, Berks.

REQUIRED, for ironfoundry laboratory, young Man to assist with control of materials, including moulding sand; some previous experience an advantage.—Apply by letter, giving details of training, salary required, etc., MORRIS MOTORS, LTD., Wellingborough, Northants.

SENIOR METALLURGIST or CHEMIST required; to take charge of the Laboratories controlling a large foundry and enamelling plant of an old-established Company in the Midlands; applicants should have a specialised knowledge of light casting foundry work and enamels for sheet and cast-iron continuous enamelling; age 30-45, and possessing B.Sc., A.R.I.C., or similar qualification; the post, which carries an excellent salary, is permanent and pensionable.—Applications, which must be marked TR/19, should be sent to Box 398, FOUNDRY TRADE JOURNAL.

WANTED, for a Light Castings Foundry in the Devonshire area, a FOREMAN MOULDER; experienced in plate moulding; must be good disciplinarian; house provided.—Reply, giving particulars of technical knowledge,, experience, and age, to Box 400, FOUNDRY TRADE JOURNAL.

WANTED, London area, fully qualified DRAUGHTSMAN; preferably with metallurgical and foundry experience.—Box 444, FOUNDRY TRADE JOURNAL.

WANTED.—FOUNDRY MANAGER; able to control modern foundry, 50 tons per week capacity; applicants must have held similar position elsewhere, and be able to furnish satisfactory references.—Box 446, FOUNDRY TRADE JOURNAL.

PARTNERSHIP

FOUNDRY MAN, with small Aluminium Foundry, would like to contact another Foundry Man that can furnish orders; consider partnership; confidentially; Midlands.—Box 430, FOUNDRY TRADE JOURNAL.

PATENT

THE Proprietors of the under-mentioned British Patents are desirous of entering into arrangement by way of a licence or otherwise on reasonable terms for the purpose of exploiting the inventions covered thereby and ensuring their practical working in Great Britain:—

Patent No. 514894: "A Method of Making Fibrous Alloys";

Patent No. 514951: "Improvements in or Relating to the Manufacture of Grey Cast Iron";

Patent No. 533724: "A Method of Casting Iron Rolls," and

Patent No. 537071: "A Method of Casting Iron Rolls."

All enquiries to be addressed to HERON ROGERS & Co., Bridge House, 181, Queen Victoria Street, London, E.C.4.